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FY 1996 TA/NIST BUDGET AUTHORIZATION

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FY 1996 TA/NIST Budget Authorizatio...

HEARING

BEFORE THE

SUBCOMMITTEE ON TECHNOLOGY

OF THE

COMMITTEE ON SCIENCE

U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED FOURTH CONGRESS

FIRST SESSION

MARCH 23, 1995

[No. 5]

Printed for the use of the Committee on Science

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*Ranking Minority Member
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FY 1996 TA/NIST BUDGET AUTHORIZATION

THURSDAY, MARCH 23, 1995

U.S. House of Representatives
Committee on Science
Subcommittee on Technology
Washington, D. C.

The subcommittee met, pursuant to call, at 1:25 p.m. in Room 2318 of the Rayburn House Office Building, the Honorable Constance A. Morella, chairman of the subcommittee, presiding.

Mrs. Morella. Ladies and gentlemen, I think I am going to commence the meeting. Others will be coming in. Thank you for waiting.

We may have votes this afternoon periodically. As you know, we are working on the Welfare bill.

As we commence this meeting, as the United States strives to move forward in this era of high technology and advanced scientific innovations, we must be prepared to take full advantage of our technological preeminence and, by so doing, there will be a corollary expansion of economic growth and opportunity driving America into the new millennium.

In Congress we are faced with the challenge of attempting to actively encourage this technological innovation, while also being forced to operate under very tight budgetary constraints.

The Members of the Majority are committed to reducing the federal spending. I am sure the Members of the Minority are also. Therefore, we must subject all federal programs to the most careful scrutiny to assure that our scarce fiscal resources are most prudently spent.

In Science and Technology it is clear that the commitment to reduce our large federal budget deficit will result in limiting our ability to fund every worthwhile program fully.

In our committee, we need to engage in a constructive dialogue and debate on each program in determining its value to our Nation's technological pre-preeminence and ability to compete in the global marketplace.

That is really the purpose of our hearing this afternoon as we examine the fiscal year 1996 budget request for the Department of Commerce's Technology Administration.

This subcommittee has budget-authorizing jurisdiction over the TA and its three components—the National Institute of Standards and Technology; the National Technical Information Services; and the Office of the Under Secretary.

The President has made an Fiscal Year 1996 budget request of $1.036 billion for all Technology Administration programs. The TA programs received a total of $872 million in Fiscal Year 1995 appropriations and, however, because of the necessity of funding defense and emergency supplemental appropriations, $157.9 million in recessions to TA's Fiscal Year 1995 appropriation passed the House.

Virtually the entirety of the President's Technology Administration budget request of $1.023 billion is designated for NIST, our Nation's oldest federal laboratory, and the only one with the expressed mission of assisting United States industry with maintaining our international competitiveness.

As many of you know, I am very familiar with NIST and its functions. Not only is it in my District, but I also served on the committee when in the 1988 Omnibus Trade Bill we renamed the old Bureau of Standards to the National Institute of Standards and Technology and added to it responsibilities for several programs designed to improve the competitiveness of American industry.

While I have been a consistent NIST supporter, I am also sensitive to the concerns of other members about the increase in this funding and the effectiveness of some of its programs, especially in light of our current fiscal constraints.

These are concerns which need to be addressed, and I welcome the substantive discussion on these issues today.

I believe this hearing should be helpful, especially to the new Members of the committee and of the subcommittee, not just for use in this committee but as these issues are debated through the Budget Committee this spring and the Appropriations Committee in the summer.

I welcome all of our distinguished panelists who are appearing before us today. Technology Under Secretary Dr. Mary Good; NIST Director Dr. Arati Prabhakar, who are going to be appearing on this first panel, and who have been waiting very patiently for a half-hour to present the President's budget request for their agencies.

The second panel will feature witnesses who will discuss the Advanced Technology Program, the ATP program, which is a NIST extramural program; the Manufacturing Extension Partnership, the MEP. Another NIST extramural program will be the focus of the third panel.

All witnesses have been asked to limit their oral testimony to five minutes. The full text of their testimony indeed may be submitted into the record.

I will recognize all of the witnesses in each panel before we have questions from the Members, and each Member, alternating between Majority and Minority, will have five minutes for questioning.

I am going to recognize Members in the order in which they arrived here at the subcommittee hearing.

At this time, I would like to make an unanimous consent motion that the hearing record be held open for five legislative days for inclusion of testimony to be submitted by members of any interested parties.

[No response.]

Mrs. MORELLA. If there is no objection, the motion is agreed to.

I see that our Ranking Member is not here yet, but I have the vice chairman of the committee who is here, and I would like to—

Talk about perfect timing.

As I yield time to the Ranking Member, Mr. Tanner, I would like to thank him for his input in selecting many of the witnesses for today's hearing, and look forward to continuing to work with him in the future.

Mr. Tanner?

Mr. TANNER. Thank you very much, Madam Chairman.

I apologize for the delay. Our bill is on the Floor, and we will try to do better on our time.

I want to thank you for holding this hearing. For the sake of time, I would like to summarize my opening remarks and ask unanimous consent that I be allowed to submit a written statement.

I would also like to ask unanimous consent for five days for inclusion of testimony or other extraneous materials that Members might want to include.

Mrs. MORELLA. Without objection.

Mr. TANNER. In 1904 a fire broke out in Baltimore that destroyed more than 1,500 buildings in an area covering more than 70 blocks. When fire companies from Washington, New York, Philadelphia, Annapolis, Wilmington, Chester, Altoona, and York arrived at the city, it was like a Keystone Kops comedy.

They discovered that few of their hoses matched each other or the local hydrants. What was the problem? Because there were no uniform thread standards, the Great Fire of Baltimore destroyed most of the city.

It took this kind of catastrophe for the government to realize that it simply could not rely totally on free-market policies, but that we needed something along the lines of a National Bureau of Standards so that we could set some standards and avoid this sort of calamity in the future.

Under the Reagan Administration, the 1988 Omnibus Trade Bill expanded NIST responsibilities to include actively assisting U.S. businesses to develop high-risk enabling technologies and helping small and medium sized businesses meet the challenge of global competition.

Might I say here, global competition has been defined in some quarters as the ability of American companies and American firms to sell abroad.

I would suggest global competition occurs every day on Main Street America because everyone else in the world is coming here to sell their products.

So I think it is a very narrow, parochial view to say that global competition is only occurring when American firms are trying to sell abroad.

That is not in my statement, but I thought I would add it, Madam Chairman.

[Laughter.]

Mr. TANNER. I have had first-hand experience with a MEP program in my State of Tennessee working with the University of Tennessee, and I saw—and I would like to also add that the Tennessee delegation has received more than 100 letters this past month alone from small and medium sized businesses in support of these types of programs.

I will stop here, I think, Madam Chairman, because I know a couple of the Members on the Minority want to make a statement and I do not want to take all the time, if that is agreeable.

Mrs. MORELLA. Thank you.

The entirety of your statement will be placed in the record, Mr. Tanner. Thank you.

[The prepared statement of Mr. Tanner follows.]

The Honorable John S. Tanner (D-TN)

Ranking Member, Subcommittee on Technology
Committee on Science
U.S. House of Representatives

Authorization for the Technology Administration/
National Institute on Standards and Technology
Fiscal Year 1996

March 23, 1995

Opening Statement

In 1904 a fire broke out in Baltimore that destroyed more than 1,500 buildings in an area covering more than 70 city blocks. When fire companies from Washington, New York, Philadelphia, Annapolis, Wilmington, Chester, Altoona, and York arrived at the city, like a Keystone Kops comedy, they discovered that few of their hoses matched each other or the local hydrants. What was the problem? Because there were no uniform thread standards, the Great Fire of Baltimore destroyed most of the city. It took a catastrophe for the government to realize that it couldn't simply rely on free market policies, but that authoritative action was needed to avoid similar problems. Thus it was that the National Bureau of Standards (NBS) began to take responsibility in the field of commercial standards.

Today, the successor of the NBS, the National Institute of Standards and Technology (NIST), supports a wide array of manufacturing activities across the country. In telecommunications, aerospace, the steel industry, pharmaceuticals, and yes, even still in fire protection, NIST continues to promote to promote U.S. economic growth by working with industry to develop and apply measurement, standards, and technology.

Under the Reagan Administration, the 1988 Omnibus Trade Bill expanded NIST responsibilities to include actively assisting U.S. businesses to develop high-risk enabling technologies and helping small- and medium-sized businesses meet the challenges of global competition. Two programs, the Manufacturing Extension Partnership (MEP) and the Advanced Technology Program (ATP), have now been functioning for almost five years. Results indicate these new programs, which are broadly supported by industry, have had wide-ranging impacts.

I have had first-hand experience with the MEP program in my own State. The State of Tennessee, working with the University of Tennessee, has supported an industrial outreach program with a proven track record of success for more than thirty years. With the addition of federal MEP funds the program has become even stronger, assisting Tennessee businesses meet the challenges of global competition. The Tennessee Manufacturing Extension Program now targets industry sectors critical to the long-term competitiveness of all of Tennessee's manufacturers -- defense contractors, vehicle manufacturing, and fabricated metal-parts manufacturers.

The Tennessee MEP is helping firms develop and implement strategies for adopting "electronic commerce" technologies, developing environmentally responsible manufacturing processes, and ensuring lean manufacturing. Officials of the Tennessee program have told me they couldn't not have made these needed changes to their programs without the boost of federal funds and the expertise of existing MEP centers.

I have seen the benefits of this program on companies in my district. In fact, the Tennessee delegation has received more than 100 letters in the past month from small and medium-sized businesses in support of this program. Typical of the letters I have received is one from a small firm in Memphis which says, " To be frank, it is rare when anything connected to a federal program has helped my small company. This is decidedly one of those times and I thought you should know." Nationwide, companies working with the original seven NIST-supported centers estimate collective bottom-line results totaling $320 million -- this is on an federal investment of $54 million.

The Advanced Technology Program (ATP) is built upon the successful DARPA cooperative industry programs at the Department of Defense. The development of the ATP program in the late 1980s was the result of a bipartisan realization that the nature of corporate research had changed. Restructuring at U.S. corporations had not only reduced the numbers of employees, but changed business practices as well. With an eye to wall Street and quarterly reports, firms now focus less effort on breakthrough technology development and relatively more on incremental technology advances and commercialization.

The ATP partnership between industry, universities, and government is an attempt to reduce risk and speed the innovation process and industry has broadly supported these government efforts. A recent position paper by the National Association of Manufacturers states "Partnerships are an indispensable tool to the private sector, and have become increasingly important in the government sector. The Advanced Technology Program (ATP) and the Technology Reinvestment Project (TRP) are the two most prominent -- though by no means only -- examples of partnerships programs." Other industry consortia, such as the Coalition for Technology Partnerships, also support these industry/federal partnerships.

As Congress and the Administration continue to work at restructuring Federal research and development programs, we should prune what doesn't work and reinforce what does work. I strongly support cutting the fat, but we shouldn't cut into the muscle too. There has been a lot of talk recently that the government should only support basic research. However, the results of basic research are available to everyone. Foreign industrial competitors are free to scoop these results and get them to the market faster. We must also strive to create partnerships which will help our businesses move high-risk technologies to the market-place.

More importantly we must maintain consistency in Federal programs. Many people, including Members on this Committee, have argued that the R&D tax credit has never been fully utilized by the industry because that it has never been made a permanent part of the tax code -- that companies couldn't make long-term R&D investments without assurance of having the credit. American companies of all sizes have made commitments to and investments in the ATP and MEP programs.

To blindly and suddenly terminate these programs for ideological reasons without any attempt at rigorous evaluation, will once again emphasize the federal government's inability to reliably partner with industry.

Today's hearing isn't about mindless bureaucrats grinding away in offices far-removed from the needs of the American public. It is about an agency that has an immediate impact on the economic vitality of the country. The results of NIST programs reach into our States, our districts, and our homes. NIST measurement services and products help U.S. companies keep their production processes running smoothly, efficiently, and safely. The industry-led and merit-based ATP and MEP programs which are industry-led and competitive-based, are creative and effective uses of taxpayers' dollars, helping industry develop new technologies and meet global competition head-on.

Ninety years ago, it took a disaster for the Federal government to realize that it could not rely solely on "market forces", that it needed to work actively with industry to ensure the efficient utilization and adoption of technology. Over the years NIST programs have evolved to meet the changing needs of American manufacturers. It is our responsibility to assist this continuing evolution and continue the tradition of working with industry to maintain a strong U.S. manufacturing base.

I want to thank Chairwoman Morella for holding this balanced hearing on NIST programs. NIST activities have enjoyed strong bipartisan support in the past and I hope that we can work together to develop an authorization bill that benefits the constituents we serve and the Nation as a whole.

Mrs. MORELLA. I would like to now recognize the Vice Chairman of the Subcommittee, Mr. Calvert.

Mr. CALVERT. Thank you, Madam Chairman.

I have no opening statement. I just would look forward to listening to the testimony and asking my questions.

Mrs. MORELLA. Thank you.

Ms. Lofgren?

Ms. LOFGREN. Thank you, Madam Chairwoman.

I have a statement I would like to insert in the record, but I would just like to make a few comments.

First, I am very happy to be here and certainly acknowledge your fine leadership in this area. I think NIST has provided crucial support to our high technology sector, and I believe that continued funding for NIST and its programs is really vital to the future success of our economy and should be one of the highest priorities we have as we look to create high-paying jobs and an export economy.

As the representative for Silicon Valley on this committee, I am well aware of many of the advances and successes of NIST in the high tech arena. I look forward to hearing more about that today.

I am also mindful that the NIST budget represents just 1 percent of our annual federal research budget, and yet this tiny investment is really a vital link in the research chain.

It really is not going to do our economy a lot of good if we have exciting new technology, but lack the ability to really translate that technology, and to move it out into the commercial and private sector.

So I am especially looking forward to hearing about ATP and MET, as well as the other intramural programs. And I will not talk further because I am eager to hear from all of the witness.

Mrs. MORELLA. Thank you, Ms. Lofgren.

I would now like to recognize Mr. Gutknecht.

Mr. GUTKNECHT. Madam Chair, I have no statement. Thank you.

Mrs. MORELLA. Ms. McCarthy?

Ms. MCCARTHY. Thank you, Madam Chairman.

I thank you for the opportunity for this hearing today. I do have remarks I would like inserted into the record and will comment just very briefly that I think, while we on the Floor this week are talking about the power of employment to change a person's life, we are considering in this committee or the full committee eviscerating an inexpensive program that creates jobs not through an entitlement or a public works program, but through enhancement and growth of existing businesses.

Madam Chairman, it is working well in my district and in my state, and I do not think the question before us should be. Can we afford NIST?

It should be. Can we afford to do without a program like this.

Thank you, Madam Chairman.

[The prepared statements of Ms. McCarthy and Ms. Lofgren follow.]

KAREN McCARTHY
5TH DISTRICT, MISSOURI

Congress of the United States
House of Representatives
Washington, DC 20515–2505

STATEMENT OF REPRESENTATIVE KAREN MCCARTHY
Technology Subcommittee, Committee on Science

Hearing on National Institute of Standards and Technology
March 23, 1995

Madam Chairwoman, what this country needs are more jobs that require skills, build new technologies, and advance the cause of our economy, science, and humanity. These are the jobs that are being created through the "extramural" programs of the National Institute of Standards and Technology: the Advanced Technology Program, the Manufacturing Extension Program, and the Baldridge National Quality Program.

Industry has recently lacked the dependable investors needed to fund capital in creating high-tech jobs. With ATP and MEP, manufacturers have that patient investor to help them make strategic and technical adjustments and craft plans for the future. That patience, that assistance, means profits and jobs.

And yet, despite the endless testimonials on the House floor this week about the power of employment to change a person's life, we are about to eviscerate a relatively inexpensive program that creates jobs not through an entitlement or a public works program, but through the enhancement and growth of existing businesses. These businesses include, in my home state, an Allied Signal plant, Southwestern Bell, and dozens of smaller manufacturers including: Clay and Bailey, American Echo, Midland Lithographing, Dematech, Butler Manufacturing, ITC Plastics, Precision Fabricators, and Package Service Co.

The Mid-America Manufacturing and Technology Center has, in my district alone, increased annual sales for its clients by $10,500,000 and decreased annual costs by $7,556,000. The average wage of the 90 jobs directly created or retained by MAMTC is over $14 an hour.

Under the President's budget for FY1996, the budget for NIST Industrial Technology Programs is $642 million. NIST isn't the final answer to unemployment or underemployment, it isn't the only answer to our need for enhanced technology, but NIST represents an inexpensive, innovative start. The questions isn't "Can we afford NIST?" The question is, "Can we afford to do without a program like NIST?"

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OPENING STATEMENT
THE HONORABLE ZOE LOFGREN
BEFORE THE
SUBCOMMITTEE ON TECHNOLOGY
HEARING ON
TECHNOLOGY ADMINISTRATION (TA) / NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) FISCAL YEAR 1996 AUTHORIZATION

Madame Chairwoman:

I am very pleased that so many witnesses were able to join us today to testify about the National Institute of Standards and Technology's programs. NIST provides crucial support to our high-technology sector, and I, for one, believe that continued funding for its programs is vital to the future success of our economy, and should be very high on our list of priorities.

I am very concerned about recent critical comments about the role of NIST programs and towards scientific research in general. Today, we will hear from several witnesses how programs such as the Advanced Technology Program and the Manufacturing Extension Program have stimulated research and development in their industry, increased manufacturing, and created jobs. As Silicon Valley's representative to this Committee, I am well aware of the current research, from laser technology to advanced software, that NIST is encouraging through its extramural programs.

It is wrong to believe that cutting corporate taxes alone will encourage private-sector R&D. Statistics have shown time and again that this is just not the case. It is naive to insist that we have little to show for our federal research efforts: the Internet is but one example of federal technology that now permeates our society. Proposals to slash federal investment in research and development are short-sighted, and bode poorly for the long-term health of our technological and scientific competitiveness.

The NIST budget represents just one (1) percent of our annual federal research budget. Yet this tiny investment is a vital link in our research chain. ATP and MEP, as well as NIST's intramural programs, provide the means to disseminate technology throughout industry, where it can be used to fuel growth, keep us competitive in the global market, and create jobs. What is the point of spending hundreds of millions of dollars on research into advanced composite materials, for example, if the fruits of this research are unavailable to manufacturers and companies?

Madame Chairwoman, I hope that our hearing today raises awareness about the importance of NIST's role in ensuring our country's place in the global market and dispels some of the myths that seems to be circulating about these programs. Let us not sacrifice our long-term economic competitiveness and prosperity in favor of short-sighted, ill-conceived budget cuts.

Mrs. MORELLA. Thank you.

And now let us hear from our first panel.

Dr. Good, we will start with you and Dr. Prabhakar.

STATEMENT OF DR. MARY GOOD, UNDER SECRETARY OF TECHNOLOGY, UNITED STATES DEPARTMENT OF COMMERCE, WASHINGTON, D.C.

Dr. GOOD. Thank you very much, Madam Chairwoman, and the other members of the subcommittee.

We are delighted to be here today. It is always a pleasure to testify to this group, particularly about the Technology Administration.

First of all, we really would like to thank you very much for having this authorization hearing, and for the continued support that you have given our efforts in the past. It has been really a pleasure to work with you, and we look forward to working with you in the future. Thank you.

What I want to talk about today—and between Dr. Prabhakar and I—I would like to sort of set the stage and give you an overview of the Technology Administration and set the stage of why these programs are so very, very important, and then give Dr. Prabhakar time to discuss specifically the programs at NIST, which are by far the biggest portion of our budget, as you know.

We want to talk about the current need for the federal involvement in promoting private-sector innovation, and to explain how the Technology Administration is involved in that process.

We think that private sector innovation, along with expanded markets for U.S. exports, a skilled and flexible work force, and a sound climate for private investment are really the four pillars of the future.

These are those pillars supporting sustained economic growth and opportunity. Each of those components is essential, and a set of policies to strengthen any one of them must take place within a framework that addresses all of them.

We are in the process of looking at that pillar which has to do with the opening markets, at least in the Department of Commerce, or opening markets for American companies.

We are also in the business of looking at innovation. But I would remind the subcommittee that the Technology Administration is the only federal entity whose only business is to assess and support the Nation's civilian technology base.

We have other mission agencies that look at the technology base that is necessary for defense. We have other agencies to look at the technology base for space and for energy, but we are really the only agency that has the responsibility for understanding what the technology needs are in the rest of the civilian sector and how to deal with that.

The agency includes the National Institutes of Standards and Technology, which you, Madam Chairman, have talked to. You know about the extensive laboratory operations that it has in your District and in Colorado. And you also know about the extramural programs which we would like to cover today in some detail.

We also, as you know, run the Quality Program which has now become a model for how one looks at quality across the country, and for that matter across the globe.

Dr. Prabhakar, since she has been at NIST, has managed to blend those programs in a way that is sort of unusual, and she wants to talk a little bit about the fact that these programs, the extramural programs, actually feed the laboratory programs, and vice versa.

These are not totally disconnected activities.

The other operations within the Technology Administration is the National Technical Information Service. This organization provides the data banks for all of the government's collection of science and technology documents.

NTIS is FEDWORLD, which is an on-line information system which has really led to a revolution in the dissemination of government collected information, including technical and business information from around the world.

It now serves over a million customers. We will not speak to that agency today specifically. There is some information in my written testimony, but as you know that is a for fee agency and therefore is not affected by the 1996 budget request.

The third component of the Technology Administration is the Office of Technology Policy which is a small but talented group of professionals who do provide the key analysis that we need to try to look at where we are and to assess the technology position of our industries, and of our country as a whole.

I will not take the time to look at all of the things that the Office of Technology Policy does today, but if I might, Madam Chairwoman, I will enter into the record just a quick list of the activities which are undertaken in my office, in the Under Secretary's office, and those in the Office of Technology Policy.

[The information follows.]

HIGHLIGHTS OF MAJOR US/OTP ACTIVITIES

OFFICE OF THE UNDER SECRETARY

Technology Administration Management: The Under Secretary's office is responsible for the day to day management and oversight of the National Institute of Standards and Technology, the National Technical Information Service and the Office of Technology Policy.

Partnership for a New Generation of Vehicles: The Under Secretary was asked by the President to chair this unique partnership among the Big Three American auto makers, eight federal agencies, universities and suppliers. The partnership has been formed to develop technologies for a new generation of vehicles with reduced emissions and fuel efficiency three times greater than cars on the road today.

Civilian Industrial Technology Committee: The Under Secretary serves as chair of the Civilian Industrial Technology Committee of the President's National Science and Technology Council. The CIT is responsible for coordinating the federal government's investments in civilian technology, and for managing several innovative public-private partnerships, including the PNGV, the National Electronics Manufacturing Initiative, and the Building and Construction Initiative.

Environmental Industry Competitiveness: The Under Secretary is participating in an interagency effort to promote the rapid commercialization of environmental technologies, and to identify and address barriers to the international competitiveness of the nation's environmental businesses.

* **Commerce Science and Technology (ComSci) Fellowship Program:** This innovative program encourages the development of broad technology expertise by selecting and placing fellows in technology related positions throughout the federal government.

OFFICE OF TECHNOLOGY POLICY

Benchmarking: Comparing one's operations against those of competitors is a well-established means of assessing and improving competitiveness. The OTP initiative seeks to expose a broader cross section of industry to the potential benefits of benchmarking and to improve the types of information provided by government to the private sector. OTP will release benchmarking studies on several key industry sectors in the fall of 1995. Over fifty of the nation's leading experts on benchmarking and industrial competitiveness are participating in the OTP effort at little or no cost to the taxpayer.

* **Federal Technology Partnerships:** OTP is evaluating the effectiveness of various partnership models used by the government for interaction with industry, and developing metrics of success for these programs. The report will be based on the experiences of the private sector and will present profiles of the programs, the funding, key features and issues.

* **Required by legislation or international agreement**

* **National Medal of Technology:** Awarded annually by the President, the Medal is our nation's highest technology award, recognizing excellence in technological innovation and commercialization. Winners have made significant contributions to American competitiveness, job creation, economic prosperity, and a higher standard of living.

Business Climate Initiative: This effort seeks to promote the enhancement of the overall climate for technological innovation by identifying, exploring, and advocating policy reforms. Based on concerns voiced by industry, this initiative provides a forum and a vehicle for consensus-building around regulatory, capital formation and other policy areas designed to improve U.S. industrial competitiveness.

* **Manufacturing Assessment:** OTP is assessing the strengths and weaknesses of the nation's manufacturing base. The results will provide insight on the make up, technological capabilities, and geographic distribution of manufacturing firms in the U.S.

* **Japan Technical Literature Program:** Under the terms of the Japanese Technical Literature Act, OTP serves as the focal point in the federal government for monitoring, translating, and disseminating Japanese technical information.

* **U.S.-Japan Manufacturing Technology Fellowships:** This program places mid-career engineers from leading American companies into Japan's top manufacturing firms for up to a year to learn about Japanese manufacturing technologies and management practices. A small investment by the U.S. government in this program leverages a much larger investment by the U.S. private sector and the Japanese government.

* **Intelligent Manufacturing Systems:** This is an industry-led worldwide set of alliances whose mission is to conduct international cooperative research and development and to promote manufacturing excellence for the 21st century. The U.S. and other participants--Japan, Canada, Australia, the EU and EFTA--are working to create private sector access to the best manufacturing techniques, technologies and systems world wide.

* **U.S.-Israel S & T Commission:** In 1993, President Clinton and Prime Minister Rabin established the commission to strengthen the private sector economies in the U.S. and Israel by promoting collaborative high technology research partnerships. In February 1995, the winners of the first U.S.-Israel S&T grants were announced in Jerusalem.

* **International S & T Agreements:** OTP participates in the review and negotiation of all of the U.S. government's international science and technology agreements to ensure that these agreements benefit U.S. industry and the nation's economy to the greatest extent possible.

* **Clearinghouse on State and Local Technology Initiatives:** This initiative provides industry with information on state and local technology programs and activities. OTP has arranged for this function to be provided by the "State-Federal Technology Partnership" (a non-profit co-chaired by the former Governors Thornburgh and Celeste, and sponsored in part by the Carnegie Commission on Science, Technology and Government), the National Technology Transfer Center and NASA. The Partnership has created the basic database for the Clearinghouse and has published the first version as "Partnerships: A Compendium of State and Federal Cooperative Technology Programs," a 640 page source book, released on January 26, 1995.

* **Required by legislation or international agreement**

Dr. Good. We are very fortunate this term to have as the Assistant Secretary of Technology Policy Dr. Graham Mitchell who is one of the known experts in the whole area of technology policy in the United States, after a very long history in the private sector of looking at strategic planning, and particularly strategic technology planning for the private sector.

So if I may, I will simply leave these issues for the record and I will not cover them in detail, but I will leave them for you all to take a look at.

My own office as the Under Secretary provides for the management oversight for these three agencies, and we make sure that the Commerce Department's customers—and our view of our customers are American business and industry—we want them to have an aggressive advocate in the development and coordination of administrative-wide technology efforts, and that these policies and programs expand economic opportunity for all Americans.

Now that last program we think is very important, Madam Chairman, because that is essentially the business that we are about.

We will speak to the details of ATP and MEP as we go forward, but let me just say a few other things to put in context for today's discussion.

One of the issues is that clearly we have over the last few years been engaged in a long discussion of the Federal Government's role in the civilian technology infrastructure of the United States. And that debate is still continuing.

In the past this has been a very bipartisan debate, and we hope that it continues that way, and it is our opinion that that is exactly the context in which the debate should happen because, you're right, in the days of constricted budgets we have to do the very best with the dollars that we can.

So the issue is.

What are the priorities?

Where should they be spent?

Are we doing the programs effectively?

Those are all really legitimate questions, and we look forward to trying to answer those as we go forward. But the landscape today has not changed.

The imperative of a global economy gets worse every day. I particularly like Congressman Tanner's comment, because he is absolutely correct. The global marketplace today affects absolutely everybody in the United States.

It no longer just affects global exporters. Because if you have a small family-owned business and you are making a product for a customer down the street, your competitors can be from anywhere, and today are from anywhere.

So it is important that every single business in the United States today is indeed globally competitive. It is beginning to be true of the service industries as well as the manufacturing industry.

So the issue of technology diffusion, both in the manufacturing community and the service community, is becoming absolutely critical if we are going to maintain the position in the global economy that we would like.

Mrs. MORELLA. I am going to ask you to finish your sentence so we can continue with—

Dr. GOOD. One last sentence. That is, technology is the engine of economic growth. There is a new study that was done by Mr. Boskin who was President Bush's Chairman of the Economic Advisers, and the end result of his study is that 50 percent of the Nation's economic growth since World War II is accountable to technology.

So we cannot be talking about a more important issue than the one we are talking about today. We think that the Technology Administration is absolutely key to our positioning ourselves appropriately in this environment.

So thank you, Mr. Chairman.

[The prepared statement of Dr. Good follows.]

STATEMENT OF MARY L. GOOD
UNDER SECRETARY OF COMMERCE FOR TECHNOLOGY

BEFORE THE
SUBCOMMITTEE ON TECHNOLOGY
HOUSE COMMITTEE ON SCIENCE

THE TECHNOLOGY ADMINISTRATION
MARCH 23, 1995

Madam Chairwoman and members of the Subcommittee, it is a pleasure to testify before you today on the status and direction of the Department of Commerce's Technology Administration.

Madam Chairwoman, I would like to begin by thanking you for holding this authorization hearing, and for your continued support of the Department's technology efforts over the course of your career. It has been a pleasure working with you in the past, and I sincerely look forward to our work together in the future.

I am here today to discuss the current need for Federal involvement in promoting private-sector innovation, and to explain how the Department of Commerce, and the Technology Administration, in particular, is successfully addressing this need.

We think that private-sector innovation, along with expanded markets for U.S. exports, a skilled and flexible workforce, and a sound climate for private investment are the four pillars supporting sustained economic growth and opportunity. Each of these components is essential; and a set of policies to strengthen any one of them must take place within a framework that addresses all of them.

I think that every Federal Department is working, in one way or another other, to strengthen one or more of these pillars. The Department of Commerce, for instance, has made historic progress in opening markets for American companies through the successes of agencies like the International Trade Administration, the Bureau of Export Administration and the Patent and Trademark Office. The Commerce Department has also made impressive headway in encouraging private-sector innovation through the efforts of the Patent and Trademark Office, the National Telecommunications and Information

Administration, the Economics and Statistics Administration and the Technology Administration.

But the Technology Administration is the only federal entity whose *only* business is to assess and support the nation's civilian technology base. The agency includes the National Institute of Standards and Technology (NIST) , with its extensive laboratory operations and its extramural programs in Manufacturing Extension, Advanced Technology and Quality recognition and promotion. Dr. Arati Prabhakar, the Director of NIST, will follow me with a detailed analysis of the NIST programs, so I will not discuss them in much detail this afternoon.

The Technology Administration also includes the National Technical Information Service (NTIS) , which provides the data banks for the government's vast collections of science and technology documents; NTIS's FedWorld, an on-line information system, has led a revolution in the dissemination of government-collected information — including technical and business information from around the world — to a wide audience of customers.

The third component of the Technology Administration is the Office of Technology Policy (OTP), which is a small but talented and dedicated group of professionals who provide the key analyses we need to make policy decisions and to assess the technology position of our industries and the country as a whole.

My office provides the management oversight for these three agencies. We make sure that the Commerce Department's "customers" — that is, American business and industry — have an aggressive advocate in the development and coordination of Administration-wide technology efforts; and that these policies and programs expand economic opportunity for *all* Americans. This last point about our activities is particularly important, Madam

Chairwoman, for many of our programs, like the Advanced Technology Program, have been unfairly likened by some to "corporate welfare."

I believe that nothing could be further from the truth. "Corporate welfare" would offer companies what amounts to an entitlement to an operating subsidy, creating a dependency on government assistance that is both irresponsible and wasteful. "Corporate welfare" might boost a company's short-term profits, but it does little to increase the firm's *and the Nation's* productive capacity.

This does not describe our endeavors, and it certainly does not describe the Advanced Technology Program. The ATP, for example, is cost-shared, with industry footing on average over half the bill for investing in enabling and emerging technologies — investments which may actually reduce their short-term profits in order to promote their long-term competitiveness. The ATP is rigorously competitive, with private- and public-sector experts assessing both the technical feasibility and the business plan of each project. The program's participants are strictly accountable for the work they have undertaken with taxpayer assistance, and the project awards have very clear time limits.

Do participating companies stand to profit from the ATP partnership? Of course they do, but only because they invest their own resources in developing technologies with a significant potential commercial impact. More importantly, while economic benefits of private-sector innovation must be fully captured by the companies who invest in R&D and who capitalize on their investments by making better products and services, the benefits of innovation are broad-based: The improved products and services borne of successful R&D efforts benefit American consumers with higher-quality, lower-cost goods; and they make the producing firms more competitive. Over time, as consumers and suppliers gain from each producer's success, and as new technologies create new markets and new companies, the benefits of this technology partnership ripple throughout the Nation's economy.

I came to my position as Under Secretary for Technology from a somewhat varied background. I spent over 20 years in the Louisiana State University system as a Professor of Chemistry and a Professor of Material Science in the Engineering Research Division. I followed that experience with 13 years in industry as a research manager and finally a Senior Vice President for Technology for Allied Signal, a company with extensive businesses in aerospace, automotive components, and chemical products. I also spent 11 years as a Presidential Appointee on the National Science Board, with three of those years as the Chairwoman of the governing body of the National Science Foundation. I also spent two years on the President's Committee of Advisors for Science and Technology during the last Administration.

I provide this background only to indicate that my views on science and technology policy are colored by my experiences in basic science, commercial research and development, and science and technology policy. This background and my interest in what I perceive to be one of the greatest issues for the future convinced me to accept this Presidential appointment to help guide and manage the government's civilian technology efforts.

Madam Chairwoman, the political landscape may indeed have shifted in recent months, but one thing has not changed: the imperative of a new global economy. I believe that our job — to ensure that American companies and workers meet the challenge of a changing world — remains one of the highest priorities for the federal government.

We believe that technology is the engine of economic growth — at least that is what a vast body of respectable economic research teaches us. What Robert Solow proposed in his legendary economic growth model, finds a deepening well of support today. Recent economic research, for example, attributes roughly 50 percent of the Nation's economic growth since World War II to technology.* I ardently believe that the Federal government has the capability and the responsibility to help American companies and workers meet the challenge of this period of fundamental economic transition by promoting civilian technology.

The government's civilian technology efforts were started and developed for one principal reason — to strengthen U.S. competitiveness. They resulted from a bi-partisan consensus to address a recognized need that emerged in the mid-1980s, that U.S. workers and firms must maintain the sharpest competitive edge in an economy that pits their efforts against those of able competitors from around the world.

The Cold War may well be over, Madam Chairwoman, but a new battlefield has emerged in the form of a global marketplace; and able competitors from around the world are fighting for a share of it. What this means for the Nation as a whole is that our economic security is as critical as our military strength in protecting the country's future. What this means for American businesses and workers is that their ability to compete — to produce the highest quality goods and services at the lowest possible cost — has never been more important. What this means for all of us in this room, everyone whose business is federal s science and technology policy, is that promoting civilian technology has never been more critical to our country's economic future.

Our programs and policies have been guided and shaped by a set of unshakable principles. Let's now take a few minutes to explore both the principles of government's involvement in civilian technology efforts and the history of federal science and technology policy.

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* Boskin and Lau, 1992.

I will start by saying up front something I think we can all agree on. Clearly it is the private sector that is responsible for the production of competitive products and processes and the creation of wealth and new jobs. The government cannot fulfill these obligations and must let the market drive where these technologies need to be nurtured.

However, the approximately $70 billion of research and development funding that is spent by the Federal Government is for the most part in areas that are widely recognized as the appropriate role for government. For the past 50 years, during the Cold War era, we have funded basic research, particularly at our universities, and we have provided the resources for our mission agencies to do the necessary applied research and development to meet their mission goals. These mission-related activities are a major share of the $70 billion and they, over time, have contributed to overall health and prosperity. The early investments in electronics and aerospace by the Department of Defense helped to create our world-class computer and aerospace industries. The dedicated research funding for the National Institutes of Health has been the major source of the creative ideas which have led to major discoveries and developments in the pharmaceutical and medical industries. In addition, mission-related research has provided many breakthroughs in energy conservation and energy development which would not have been profitable for the private sector. Finally, the space technologies developed by NASA have made major contributions to the private sector in the form of new materials, better aerospace components, and new satellite communications systems, just to name a few.

Thus, for the last 50 years our science and technology policy has been to support fundamental research in our universities and at the same time create one of the best cadres of technical talent in the world. The basic science effort was coupled with our mission-related applied research and development, which provided significant "spin-off" benefits to those sections of the private sector which met the mission goals of the Defense Department, the Department of Energy, NIH, and NASA. At the same time, many of these investments seemed extraordinarily high risk, and indeed some paid off and others did not. But the fact that many of these technology missions were high risk did not deter us from seeking successful technologies to achieve our missions. During those 50 years, we also had an industrial sector which used a significant portion of its income to build a technology base through the legendary corporate laboratories of companies like General Electric, DuPont, AT&T Bell Laboratories, and others that all of us could name.

Thus, our technology policy of the past 50 years has been successful. But it's now 1995, not 1945. The world is very different than it was then, and we must change our policy approaches to meet new challenges.

For example, even our definitions of research and development are changing: Let's take the distinction between basic and applied research. One problem, Madam Chairwoman, is that it is not always easy or useful to pigeonhole research as "research undertaken for the purpose of gaining a fuller knowledge of a subject without regard to practical applications," the definition of basic research, or as "research undertaken to gain the knowledge as to how a specific need can be satisfied," the definition of applied research. Would anyone really feel comfortable saying research undertaken to get a better understanding of cellular biology is basic, but the exact same research undertaken to get an idea as to how we might develop a treatment for leukemia is applied or developmental research?

Those of us who, like myself, have spent 15 years in industrial research laboratories, know that such distinctions are not too useful, and especially not if based on the so-called "purpose" or motive behind the research. Every dollar that my former employer spends on R&D is an investment in future profits; every bit of it is intended at some point to be applied to something related to the company's line of business. However much the bench scientist may be motivated by a thirst for pure knowledge, the vice president for R&D, the CFO, the CEO, and the stockholders are all motivated by the expectation that the findings will be put to practical use for the company. The same argument can be made about basic energy research and the search for solutions for improved energy efficiency conducted in a variety of energy-related industries. To the extent we make distinctions in classifying research, perhaps we should think of research according to the time frame — that is, as having short-term or long-term payoff potential. Or perhaps we should think about the distinction between pre-competitive, or generic research and commercial product and process research.

In addition to the closing gap between basic and applied research, two other significant changes have taken place in the last few years which make traditional technology policy inadequate for the next century. The first of these changes is the brutal competitiveness of a global economy where products and services can be delivered from all over the world. To be able to compete, American companies — large and small — must provide high-quality products at competitive prices, and deliver them in a timely fashion. These global competitive pressures have forced our industries to rethink their decisions to invest in a broad technology pool, which provided technology for themselves, but also spilled over for the good of the country and the world at large. Thus today, instead of investing in broad-based central laboratory activities, we find our industries devoting 90 percent or even a higher portion of their available investment resources into shorter-term product development and process improvement. This is not an indictment of the industry, but an acknowledgment that intense, global competition requires a focus on providing competitive products with short lifetimes and generally lower margins.

Secondly, the current product life cycle requires the renewal of products or the replacement of products by new ones on a much faster time scale than our old, linear research-to-product development model would allow. In the electronics industry, for example, the lifetime of a new model of personal computer is less than two years.

In short, our old way of doing business, where we expected the industry to develop much of its own long-term enabling and emerging technologies with a new product cycle of 15 years is obsolete and simply unworkable. Today we must rethink how this system works and what we can do to support it, so that it helps American companies and workers compete and win in the global economy. We must promote a system that encourages U.S. firms to conduct R&D and advanced manufacturing here in the United States, which will create high-wage jobs and strengthen the nation's intellectual environment for future research.

One reaction among U.S. businesses to some of the changes I have just described has been to *outsource* their R&D activities. Corporations which once relied solely on their private laboratories for the bulk of their R&D needs, now find external sources of technology in other companies, universities, industry consortia, or Federal laboratories. The mechanism that has made the outsourcing of technology an appealing option to companies is the emergence of partnerships.

It is simply not enough to invest in basic research and mission R&D and hope that our industrial sector will be able to utilize that technology base in a timely and effective manner. All of our effective national competitors have looked at ways to bridge this gap, and many of them — especially Europe and Japan —spend significantly higher portions of their budget on this than we do. It is my view that our approach of using industry-led partnerships is by far the most efficient and cost-effective strategy. In fact, I believe that we will not have the growth in our technology-based industries at the turn of the century that will sustain our momentum unless these partnership activities are not only engaged in, but well executed.

I believe that we have a responsibility to promote technology partnerships with industry, which help bridge the investment gap between shorter- and longer-term research; to ensure access to existing technologies through manufacturing extension services; make government, scientific and technical, and business information widely available to the public; to help U.S. companies gain access to valuable foreign science and technology; and to promote a business climate that fosters private-sector innovation and maximizes its impact on economic growth.

Madam Chairwoman, the Technology Administration is the only federal entity tasked with fulfilling these critical responsibilities. This year's proposed budget will enable TA to help strengthen the economic competitiveness of our businesses and workers — and assume the responsibilities that other governments have taken for several years.

National Institutes of Standards and Technology

As I mentioned earlier, Dr. Prabhakar will provide extensive details about NIST's programs. But I would like to say a few words about our two most prominent public-private partnerships — the Advanced Technology Program (ATP) and the Manufacturing Extension Partnership (MEP).

- I believe that the **Advanced Technology Program**, for which we are requesting appropriations of $491 million this year, is the government's most important civilian technology effort. This industry-driven, cost-shared, partnership encourages companies to invest in developing longer-term, higher-risk, potentially high-payoff technologies. ATP awards do NOT support product development, marketing, etc.; they go to civilian technologies that may not otherwise be developed because they are too costly for individual companies to undertake alone or in a marketable time frame. ATP awards go to companies of all sizes on a rigorously competitive basis. In fact, roughly half of the ATP awards have gone to small companies or to joint ventures led by small companies. The program allows for "market pull" exploitation of our science and technology base since industry conceives, designs, proposes and executes the projects. Companies also have to provide for a significant share of the costs — on average, more than 50 percent.

- The Administration requests $147 million for **Manufacturing Extension Partnership**, which would push us to our goal of creating a nation-wide network of 100 manufacturing extension centers, offering technical assistance to the nation's 370,000 small- and medium-sized manufacturers. A recent study published by the Economics and Statistics Administration highlights the importance of technology in

U.S. manufacturing plants. Specifically, the study found that firms using advanced technologies had significantly higher wages, employment growth, and success rates than firms who don't.

National Technical Information Service

This fee-supported agency provides extensive public access to government, scientific and technical, and business information from both this country and abroad. The Agency plays an important role in the Nation's technology infrastructure by making valuable federal R&D results available to researchers. In the past three years, NTIS's online information network, FedWorld, has become a central component of the Agency's information dissemination services. Starting as a simple electronic bulletin board, FedWorld now offers access to over 130 other government systems, providing public access to information ranging from IRS tax forms to key business indicators.

Office of the Under Secretary for Technology/ Office of Technology Policy

The Office of Technology Policy conducts the critical analysis needed to develop effective technology policies; the agency also manages several international science and technology agreements. OTP will soon provide a Congressionally-mandated report on Federal technology partnerships. The analysis presented in this document provides us with valuable guidance for strengthening, streamlining, or even eliminating specific technology transfer activities of the Executive Branch. Once published, OTP will join an interagency effort to implement changes which would dramatically improve the government's technology transfer efforts.

In the coming weeks, OTP will also deliver to Congress the findings of its manufacturing assessment study, which analyzes the diversity of U.S. manufacturing and provides a detailed analysis of the manufacturing sector's impact on the Nation's economy. I can think of no more important piece of information that is needed for our continued debate on the technology needs of our manufacturing industries.

In addition to these efforts, OTP continues to conduct its benchmarking activities, an effort designed to assess the technical and competitive position of certain industry sectors; and the Office plans to begin an analysis of the services sector; build upon the annual assessment of the U.S. manufacturing base and begin an assessment of the development and implementation of government-wide manufacturing strategies; study the impact of the workplace on productivity in the manufacturing sector; increase U.S. industry's access to foreign science and technology by expanding the Japan Technology program to cover the Pacific Rim, Europe, and the Western hemisphere; support international S&T agreements, including third-year funding for the U.S.-Israel Science and Technology Commission.

Our management of the U.S.-Israel Science and Technology Commission (US-ISTC) is an important venture we've undertaken in the past year, and one that could benefit American business and industry enormously. The Commission would help ensure that our firms have access to critical science and technology information by facilitating joint partnerships with Israeli firms. This bi-lateral project with Israel will also promote the peace process in the region by supporting economic development.

As I mentioned earlier, my principal responsibility as the Under Secretary for Technology is the management and oversight of our three agencies, making sure that our policies and programs reflect the needs of both business and industry and that they help provide economic opportunity for all Americans. My office also serves as an advocate for efficient and effective civilian technology efforts throughout the Federal government. President Clinton, like his predecessor, President Bush, understands the importance of having a figure at the Under Secretary level, who speaks about civilian technology efforts, and serves as an advocate for and coordinator of these efforts.

As the Under Secretary for Technology and chair of the National Science and Technology Council's Committee on Civilian Industrial Technology, I feel that I am in the unique position to both coordinate Administration-wide technology efforts and keep them focused, effective and efficient. I think that one of the most exciting and important interagency initiatives is the Partnership for a New Generation of Vehicles (PNGV)

My office coordinates the government's interagency participation in the PNGV. This is a historic public-private partnership that will benefit not only the 1 in 7 American workers in auto-related industries. This partnership will help make sure that one of our nation's most important industries stays competitive as we enter the next millennium. It will benefit American consumers, who will be able to buy cars that are more fuel-efficient and cause less pollution, but that are comparable to existing vehicles in safety and amenities. It will also begin to reduce our trade deficit in oil imports and our dependence on foreign oil products.

CONCLUSION

The Technology Administration has demonstrated to industry, to universities, and to foreign governments that it understands the concerns of U.S. businesses and workers and can be an effective advocate for promoting our nation's competitiveness.

Working closely with Office of Science and Technology Policy's Director, Jack Gibbons, through the Committee on Civilian Industrial Technology of the National Science and Technology Council, and through programs like the Partnership for a New Generation of Vehicles, the Advanced Technology Program and the Manufacturing Extension Partnership; we are encouraging industry-led partnership with the government and the academic community. And I believe that we are well on our way toward reorienting the government's science and technology base to enable the private sector in years to come. But these initial years are so critical — they are when the marginal impact of our investments is highest, and they are when they may seem the easiest to thwart, because many of the benefits come down the road.

I believe that the Technology Administration is the only government agency that is empowered to fulfill these important responsibilities; and help safeguard America's economic prosperity as we enter a new era. We are making a difference and we need your continued support. Thank you.

Mrs. MORELLA. Thank you very much, Dr. Good.

If there are other points you want to bring out, I am sure in the Q and A's, they will come out.

Dr. GOOD. We will have that opportunity. Thank you.

Mrs. MORELLA. Dr. Prabhakar?

STATEMENT OF DR. ARATI PRABHAKAR, DIRECTOR, NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY, GAITHERSBURG, MARYLAND

Dr. PRABHAKAR. Thank you very much.

It is a real pleasure to be here with all of you to discuss the programs of the National Institute of Standards and Technology.

Let me just begin by saying, Madam Chairwoman, how much we have appreciated your staunch support over the years. Your opening comment was very much on track in the sense that we quite literally would not exist but for the work of this subcommittee.

I think that the vision that this subcommittee showed in really asking the old National Bureau of Standards to step up to some of these new challenges to me was a message that said that you recognized that our relationship with industry, our focus on partnering with industry, rather than having a traditional sort of top-down or adversarial relationship, that that was exactly what we needed to do some of these new jobs.

We think we are living up to that promise, and that is really what I would like to try to address today.

Under Secretary Good in her testimony I think does an excellent job of describing the kind of links that we need to to try to create between the $70 billion in federal R&D investment that we made for many, many years on the one hand, and on the other hand the $85 billion a year that our private-sector spends on R&D.

If you look at the work that we are doing in NIST, we are very tiny part of the overall federal or even the complete national R&D investment. But I think that in fact we are a very critical part of some of the bridging programs, the industry/government partnership programs that are really designed to try to connect the $70 billion of science and technology based mission-oriented technology activities to industry's own efforts which are increasingly focused on narrower and shorter-term product development activities.

I think the global realities that we live in mandate that companies continue to get increasingly efficient in their R&D activities. I think is something we should applaud.

But at the same time, we need to recognize that the gap between the public investment and the private investment is widening, and that we do need some mechanisms to address that.

That is really where NIST lives and breathes. Our programs have grown quite rapidly in the last few years. That is not an accident. It was an absolutely deliberate strategy to try to build some of these bridges again in the nature of industry/government partnership programs.

We have put a lot of focus and attention into trying to do that job very well and deliver value to our long-term economic prospects, rather than building a lot of bureaucracy.

I would be happy to discuss the details of that.

I wanted in my few minutes to just comment that, first of all, our work at NIST is actually a portfolio of four different programs—different tools for different needs.

Underpinning all of our work are a set of principles, four principles, that really guide everything that we do.

The first one is I think the critical issue that is much at the center of this debate. That has to do with the appropriate role for federal R&D.

We feel very strongly that the appropriate role for federal R&D continues to be the investment in the long-term, in the risky technologies, in the infrastructural technologies.

Let me tell you what we do not think it includes. We do not think it includes building factories, buying land, doing product development, doing manufacturing, marketing, sales, distribution. Those are the jobs that our companies do extremely well.

We think we should celebrate the free market economy and how vigorously it operates in this country. Our companies are superb at taking technology and turning it into products and services and the profits and the jobs that really drive our economy.

But we think the appropriate role for our investment in this government—I think in contrast to other countries—is to focus again on the long-term, the risky, the infrastructural technologies to do with industry the jobs that we cannot do separately. Let's do them together because they matter for companies but also for our long-term economic prospects.

The second key principle is that our priorities are driven by industry. You will find that in everything we do the work really begins with industry's needs and its ideas about what really needs to be tackled in this arena.

Third, all of our funds are allocated on the basis of a rigorous, competitive, merit-based process in the history of the Advanced Technology Program and the Manufacturing Extension Partnership.

We have had no earmarking, so no Congressional earmarking, but also no political process within the Administration's really merit-based process.

Within that, I should just note that small companies I think have done extremely well. I think we have been able to create a level playing field, and you will see a much more active participation of small companies in these programs I think than in any other part of federal R&D activity.

The fourth principle focuses on evaluation. We are building on a long tradition of evaluating the results of our work.

Quite fundamentally, I think what we are doing is something that is new in the way we have thought about the national, the federal role in R&D. We do need to be very clear on measuring the benefits both in terms of the immediate impact with the companies we work with, but really ultimately the broader based economic benefits that flow to the entire society.

My full statement, which I would like to submit for the record, has some details about how we are delivering on these programs.

Let me just mention very quickly that I think in our laboratory programs we have made the first really discernible increase in budget, and therefore in program activity, literally in decades.

In the last couple of years we have been able to strengthen that activity and, as Dr. Good indicated, I think we are beginning to reap some of the benefits of the kinds of interactions as our labs help ATP, and as our ATP interaction helps our labs, and in turn become reinvigorated.

My testimony speaks to some of the advances we have been able to make there.

Our new programs as well, the Advanced Technology Program and Manufacturing Extension I think are making rapid progress and are building the kinds of new capabilities, new relationships with the industry today that will lead to the broad-based economic benefits that we are really investing in for taxpayers for tomorrow.

Madam Chairwoman, let me just wrap up by saying that I am serving in this position today because I believe that this small investment, relatively small investment, is a vital complement to industry's own R&D investments of $85 billion a year.

We are all fully aware of the pressures on the budget, and I think the easy solution is often to look at what is new and different and start with that as the place to cut.

But in fact, I would advocate that these programs are explicitly designed to maximize value for today's realities. I believe that these programs offer the greatest economic bang per buck of any part of the $70 billion we invest in federal R&D, and therefore I would suggest that this is in fact the last place that we ought to be cutting back in federal R&D across our portfolio.

I am very pleased that the committee is taking a good, hard look at those issues. I think that is very, very important.

We are building on a strong base that this committee helped form. Our programs are designed and implemented and evaluated with industry, and with a constant focus on the long-term broad-based economic results.

That is why everyone at NIST comes in to work in the morning, and that is really how we measure our value to the taxpayer at the end of the day.

Let me just conclude with that and say I would be happy to answer questions.

[The prepared statement of Dr. Prabhakar follows.]

STATEMENT OF ARATI PRABHAKAR

DIRECTOR

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

BEFORE THE

HOUSE SCIENCE SUBCOMMITTEE ON TECHNOLOGY

MARCH 23, 1995

Madam Chairwoman and Members of the Subcommittee, I welcome the opportunity to discuss with you the work of the National Institute of Standards and Technology, and to explain how our efforts are helping to strengthen the U.S. economy.

I especially want to thank the Chair for her past strong support of NIST's programs, and the entire Subcommittee for its long track record of support for NIST programs that will affect the future of U.S. industry. We literally would not be the same agency that we are today without the kind of active interest and leadership that this Subcommittee has shown.

NIST's mission is straightforward and unique. As part of the Commerce Department's Technology Administration, NIST promotes U.S. economic growth by working with industry to develop and apply technology, measurements and standards -- providing the basic technical infrastructure needed by U.S. industry. We concentrate on industry because it is industry that transforms technology into the products and services, the profits and jobs that yield the true returns to American taxpayers.

I want to put NIST's efforts into perspective by setting out four fundamental principles that drive all of our work:

- NIST focuses on critical jobs vital to the country's technology infrastructure that neither industry nor the government can do separately. These are technology jobs that private companies cannot or will not take on by themselves -- because they cannot capture the broad-based benefits that will accrue to the economy at large, or because the time-frame is too long and the risk too great. Before we take on a task, we must be assured that our efforts do not replace or substitute for any efforts by the private sector.

- Industry drives all of our priorities and plays a critical role in helping us to carry out our work. Industry's priorities, not government's, guide NIST's work.

- Rigorous, open, technically sound and competitive processes are the hallmark of all of our efforts. All of NIST's programs are strictly merit-based and have long been executed free from political influence.

- We rely heavily on evaluation of our work to ensure that industry and the taxpayers are receiving the greatest possible return on their investment.

Madam Chairwoman, I will unabashedly assert that NIST can deliver the greatest *economic* bang for the buck out of the entire $70 billion the federal government invests in research and development. Our laboratories already have a 90-plus year history of working closely with small and large companies, coupled with a reputation for neutrality and technical excellence. That is why NIST was selected by Congress in 1988 to tackle these added assignments -- the Advanced Technology Program and the Manufacturing Extension Partnership.

Unlike any other R&D-oriented federal agency, *everything we do* is designed to partner with industry to strengthen our economy. Our successes in assisting U.S. companies are not accidental -- and they are not spinoffs. They are the very reason why we exist.

It is still too early to claim broad-based impacts on our economy for these newer programs -- they have only recently moved out of the start-up phase. But we already have indicators that point to the kinds of successes that Congress, industry and all taxpayers should demand from government investments.

I will back up those statements with some details about our efforts. But there is one other point I want to highlight.

NIST's request of $1 billion in fiscal year 1996 is the only portion of the federal budget devoted explicitly to enhancing and leveraging industry's development and use of technology -- and it amounts to less than one and one-half percent of federal R&D and one-half of one percent of the nation's total R&D expenditures. The chart (chart #1) attached to my testimony graphically displays our relative size compared with the rest of the federal R&D investment. As we talk about the value of our efforts and NIST's impact in helping industry, we need to keep this sense of proportion in mind.

NIST has a portfolio of four major programs designed to meet needs identified by industry. I would like to briefly describe each program, explaining our principles, our progress, and some of the results that we have delivered recently to industry.

ADVANCED TECHNOLOGY PROGRAM (ATP)

The Advanced Technology Program is a rigorously competitive program which invests in cost-shared research by individual companies or industry-led joint ventures. The sole aim is to develop high-risk, potentially high-payoff enabling technologies that otherwise would not be pursued at all or in the same market-critical time frame because of technical risks and other obstacles that discourage private-sector investment. These other obstacles include long pay-back horizons, or anticipated returns that are distributed so that individual firms or specific industrial sectors are reluctant to invest.

ATP is industry-oriented. While government provides the catalyst -- and in many cases, critical technical support -- industry conceives, manages, and executes each ATP project. Industry proposals are based on the private sector's understanding of market trends and future opportunities. All projects are selected on the basis of both technical and business merit through a fair and rigorous competition that draws on both government and private sector expert reviewers.

Madam Chairwoman, it remains fashionable to talk about "picking winners and losers." That phrase truly yields more heat than light. In one sense, "picking winners and losers" is the old way of setting federal R&D priorities. The federal government long ago picked agriculture, aeronautics, space, energy and health. The whole point of the ATP is to maximize economic impact by letting industry's ideas -- backed up by their financial commitment -- determine what is funded. That is the new concept in federal R&D that is embodied in the ATP.

Suggesting that programs like the ATP pick winners and losers also underrates the tremendous efforts of our industries. Consider what it really takes for a company to make a winner in the market: product development, manufacturing and production, global marketing and sales, distribution and service systems. All of these jobs belong to industry, and ATP is doing none of them. ATP's job is to cost-share the high-risk, enabling R&D that is upstream of product development, creating new opportunities for companies to pursue.

The acid test is simple: ask any ATP participant what it will take to launch a successful product in the marketplace beyond the work being performed with government-provided funding. Their own investment will always be substantially larger than the government's relatively small cost-shared funding. And that added investment comes not from the ATP, but from the private sector.

I want to address one feature about ATP that has been too often misrepresented. The ATP works for companies of all sizes -- the tiny startup, the medium size company, and the large corporation -- as well as combinations of companies. To date, about half of the ATP awards have gone to small companies or joint ventures led by a small company. That represents a much greater small business involvement than typical federal R&D programs.

But there is something much more fundamental about the ATP. Many people tend to focus on the individual companies that have competed for ATP awards -- when what we really should be zeroing in on is the benefit to the economy as a whole. Our criteria for individual projects and entire focused programs make it very clear that we are seeking to promote industry's ability to make technologically challenging efforts that will have broad economic impacts. The benefits that we are seeking will accrue not just to individual ATP participants, but to entire industrial sectors and the economy as a whole.

Take our focused program in Information Infrastructure for Healthcare. The ATP will help industry lay the foundation for the more efficient use of computer technology in doctors' offices, hospitals and clinics by cost-sharing with industry the development of innovative new enabling technologies -- technologies that will allow the medical comunity to reduce paperwork, improve the quality of diagnosis and treatment, and bring better medical care to rural areas. This program includes, for example, figuring out ways to transfer complex medical records instantly from one facility to another even though those facilities use different record formats and diffferent computer systems. The beneficiaries of this ATP focused program extend well beyond the individual companies and consortia that are cost-sharing and conducting the research. If the technical challenges can be overcome, the benefits will reverberate throughout the economy and the beneficiaries will be our entire citizenry, which ultimately picks up the $1 trillion annual tab for medical spending. A full 20 percent of today's healthcare costs is related to the processing of information, and information technology is an important ingredient for reducing those costs by many billions of dollars.

ATP Progress to Date

Overall, NIST has conducted 10 competitions and funded 177 projects to provide a little less than half the funding for over a billion dollars of high-risk research. NIST has conducted five *general ATP competitions* open to proposals from all areas of technology. Through these general competitions, we have made 121 awards, committing a total of $332 million in ATP funds with $370 million in cost-sharing funds from industry.

Through a series of public meetings with industry, we found widespread support for the idea that focused programs can help maximize the ATP's leverage by driving key strategic technology areas. Industry demonstrated that support by submitting nearly 900 ideas for focused ATP program areas since October 1993.

We have had several thousand industry representatives taking part in our ATP workshops. Those sessions have tremendous value, not just in helping to plan our program, but in convening different segments of industry to discuss mutual goals and interests.

NIST has conducted five *focused program ATP competitions*, all in 1994. We made 56 awards, committing a total of $224 million in ATP funds with $229 million in cost-sharing funds from industry. In December, based on industry suggestions, we launched an additional six focused programs. We are in the middle of those competitions now, and industry's involvement and interest is very strong.

With a total of 11 focused programs underway, the broad industry participation is evident in the range of topics: Manufacturing Composite Structures; Information Infrastructure for Healthcare; Component-Based Software; DNA Diagnostics; Computer-Integrated Manufacturing for Electronics; Materials Processing for Heavy Manufacturing; Vapor Compression Refrigeration Technology; Catalysis and Biocatalysis Technologies; Digital Video in Information Networks; Digital Data Storage; and Motor Vehicle Manufacturing Technology. These programs are each $50-185 million efforts spread over four-to-five years. Companies from every sector continue to plan new programs.

To date, more than 400 organizations, including companies, universities, independent non-profit research organizations and government laboratories have participated directly in 177 ATP projects. The attached graphic (#2) gives you an idea of the growing number of companies, large and small, that have been able to participate in this program. In addition, several hundred additional organizations participate informally as subcontractors and strategic allies. Our ATP managers have carried out a vigorous outreach program to make firms and economic development organizations in states and localities across the country more aware of the ATP, its potential, and its procedures.

ATP Impact

ATP has placed a high premium on evaluation of its programs from the very start. Our process has five elements:

- assessing ATP's own critical operational activities;
- "portfolio" profiles of applicants, recipients, technologies, and projects;
- evaluation of industry's implementation of both the R&D and business components of ATP projects;
- tracking short-term and intermediate project results; and
- measurement of long-term economic impacts.

What we really care about is that last category: long-term economic impacts. The primary goal of the ATP, and the real payoff, is the economic growth in the future that will come from the introduction of new products and industrial processes based on ATP-supported R&D. Ultimate ATP results occur significantly later than the ATP projects that cause them -- and show up throughout the economy.

But because the ATP invests only in pre-product technology development, because it is still a very modest program in terms of the larger R&D enterprise, and because nearly all of the projects it funds are still in the research phase, no one should expect to see major impacts on the economy this soon.

Having said that, we can track some early indicators that the projects are on course and the economic potential is building.

- **Encouraging high-risk R&D.** The ATP has been successful in attracting relatively high-risk R&D projects that otherwise would not be attempted.
- **Promoting research efficiencies and reduced time-to-market.** The joint ventures and alliances fostered by the ATP are reporting significant research efficiencies and early use of research results.
- **Progress on commercialization.** The results of ATP R&D projects are being incorporated into commercial products by companies. Information from 40 small companies revealed this progress:
  - 30 percent reported incorporating improvements resulting from the ATP project into existing commercial products.
  - 18 percent were implementing an improved production process resulting from the ATP project.
  - 38 percent were producing and shipping to potential customers commercial prototypes of products based on the ATP-funded technology.
  - 20 percent were producing and selling to customers products derived from the ATP-funded technology.
- **Business growth.** An important measure of the economic impact of the ATP is the growth of companies -- particularly the growth of jobs -- as a result of ATP technologies. Immediate job growth as new research staff are brought in to work on a project is not the point; rather, we focus on projections of job growth as a result of the use of ATP-sponsored technologies. Recent data from 32 small firms working on ATP projects showed that over 90 percent expected to add new employees within five years as a result of ATP technologies. Nearly half of the companies expected to add substantial numbers of employees.

Those are some of the quantifiable early results from ATP cost-shared projects with industry, and they tell us we are on track. But remembering that it is the longer-term impacts that we are aiming for, there are two far more important indicators.

First, ATP is enabling U.S. companies to see entirely new market opportunities opening up with the development of revolutionary new technologies that break all of the traditional molds.

Second, these companies often are discovering that they can best take advantage of these new markets by teaming with other firms. The ATP has stimulated the formation of strategic R&D alliances both *horizontally*, among competitors, and *vertically*, between customer and suppliers.

Two examples provide insights about how ATP is meeting its goals and serving industry.

The Genosensor Consortium

One goal of the Advanced Technology Program is to help industry change the rules, to provide a springboard for revolutionary technological advances harboring big economic potential. An ATP project now under way by the Genosensor Consortium fits this ideal like a hand in a glove.

One of the consortium's major technology goals is to develop DNA analysis technologies that will take off where the Human Genome Project (HGP) stops. The HGP is a federally funded, multibillion dollar effort to map and ultimately sequence all human genes. An early payoff is expected to come in the form of more reliable and inexpensive diagnostic tools that can help reduce health care costs and human suffering through earlier intervention or lifestyle changes. In the longer term, the basic genetic knowledge developed in the HGP could help change the paradigm of medical practice. Rather than being relegated to responding to health problems that already have emerged, doctors could begin to shift their focus to managing -- even preempting -- potential health problems revealed through DNA analysis.

The Genosensor Consortium's six companies, two academic institutions, and independent research organization hope to realize that vision by developing plug-and-play, tabletop instruments capable of inexpensive and rapid analyses of DNA samples. This is the kind of tool that can convert the vast storehouse of data coming from the HGP into useful information valuable to doctors and patients, biotechnologists, public health officials, and many others. In addition, these same tools could open doors to more effective microbial screening of water supplies and food, to more affordable large-scale toxicological screening, and to more effective genetic engineering of plants and animals, and to chemical manufacturing applications.

That such a technology is needed is clear. With today's analytical methods, it takes days or weeks, skilled technicians, and at least $100 for even the simplest DNA analysis. By synergistically combining the fields of microelectronics and molecular biology, the consortium aims to unlock the widespread potential of DNA analysis and develop an easy-to-use machine that can do analyses in less than an hour at a cost at or below $10.

It is no surprise that the R&D challenge here is formidable, expensive, and risky. It requires the equivalent of miniaturizing a room-sized analytical laboratory onto a chip. With the ATP serving as the catalyst, the consortium formed because no one company had all of the in-house expertise in chemistry, biology, software design, microfabrication techniques, system engineering, and other technical areas to even prove the concept of a tabletop DNA analyzer. The ATP is providing a framework in which the financial and technical risks for each consortium member come down to acceptable levels. Consequently, by encouraging companies to share the risks, the ATP promotes the aggressive development of revolutionary technology that has historically paved the road to broad U.S. economic prosperity.

Auto Body Consortium

Assembling car bodies has a lot in common with assembling jigsaw puzzles. In both cases, each of many pieces must fit nearly flawlessly with its neighbors. Even minuscule misfits and misalignments can accumulate into unappealing results. The challenge for U.S. auto makers is to achieve manufacturing uniformity that improves quality, reduces costs and shortens time to market. Uniformity also is the key to tighter fitting doors, less wind noise, and fewer rattles and vibrations, all of which play pivotal roles in the perceptions and decisions of car buyers.

That is why in 1992 eight small technology suppliers joined to form the Auto Body Consortium (ABC) and teamed with General Motors, Chrysler, and researchers at the University of Michigan and Wayne State University. The ABC credits the ATP as the catalyst for this trailblazing collaboration. The government provided $4.8 million to the consortium of small companies. GM and Chrysler together pitched in $2.25 million of the nearly $6.5 million of matching funds required in the ATP agreement. In only three years, the effort has yielded versatile new software, mathematical techniques, manufacturing technologies, and ways of transferring information among researchers, suppliers and automakers. Together, these innovations can reduce the total variation of U.S.-made car bodies from the typical 3-5 millimeters to 2 mm or less -- roughly the thickness of a nickel. Toyota already had reached that level of uniformity to become the industry benchmark. European and other Pacific Rim rivals have been closing in. Now, because of the unprecedented common ground that the ATP provided -- even for arch rivals -- U.S. industry has caught up to the leaders. What's more it has done so in a way that promises a long-term competitive advantage. Similar to Toyota's approach, the ABC techniques and technologies maximize worker contribution, yet the ABC approach also harnesses America's unique advantage in innovative manufacturing technologies. The goal has been demonstrated in the manufacture of several vehicle models at the Chrysler Jefferson North (Michigan) assembly plant, the GM Shreveport (Louisiana) plant and the GM Linden (New Jersey) plant, where it took only 15 weeks to reduce variation levels to a world class 2.00 mm. Now that level is down to 1.74 mm. As discoveries have been made during this ATP project, which officially ends in September, industry has invested quickly to rapidly implement the newly validated manufacturing technologies into their assembly lines. With this proof that collaborative R&D can work, many in the auto industry seek to replicate the ABC model in other major manufacturing steps including metal stamping, welding and joining.

MANUFACTURING EXTENSION PARTNERSHIP (MEP)

The Manufacturing Extension Partnership is a true grassroots effort to improve the competitiveness of smaller manufacturers: companies with fewer than 500 employees that number more than 370,000 and account for about 95 percent of all U.S. manufacturing plants. The MEP helps these smaller manufacturers succeed in the marketplace by allowing them to improve their operations through the use of appropriate technologies. The computer revolution has yet to arrive at a surprising number of these firms; many still are using manufacturing technologies from the 1950s and 1960s. Meanwhile, competition overseas is getting tougher by the day.

These smaller companies are assisted by manufacturing engineers from MEP's growing nationwide network of affiliated manufacturing extension centers run by local, state and non-profit groups. The MEP takes maximum advantage of programs already in place, avoiding duplication of efforts among existing technology assistance organizations. It concentrates on matching company needs to available help regardless of source.

The MEP provides federal funds to both existing and new extension centers so that they can meet the needs of area manufacturers. All centers are chosen in rigorous, merit-based competitions, and all federal funding must be matched by the state. The MEP includes the State Technology Extension Program, offering support to states and communities so that they can begin building the foundation of organization relationships required for the efficient delivery of services, which might include a Manufacturing Extension Center. We are placing a very high priority on working with those areas of the country which do not yet have this foundation in place.

Having a nationwide system managed through NIST offers the centers a system-wide array of supporting services and information resources -- and discourages duplication of effort. As conduits to MEP client companies, the centers can increase the depth and breadth of expertise readily available to local firms.

As the client companies become more competitive, their prospects for long-term growth improve. So do opportunities for retaining existing jobs, creating new high-skill, high-wage jobs and reaping economic benefits related to maintaining America's value-added manufacturing industry, and additional service industry jobs needed to support that manufacturing base.

MEP Progress to Date

In 1993, fewer than one smaller manufacturer in 20 was located within the service areas of the seven federally sponsored extension centers. Since then, dramatic progress has been made. Now, 44 MEP centers are operating or are preparing to open their doors in 32 states. Those non-profit centers employ professional engineers and others with manufacturing or business experience who are opening the doors to information and expertise for small manufacturers.

MEP partners with state and local governments to establish non-profit manufacturing extension centers in the nationwide MEP. These centers leverage state, local, and regional programs along with a widening national array of assistance efforts.

This expansion has been enabled by the Technology Reinvestment Project (TRP), led by the Defense Department's Advanced Research Projects Agency. The TRP has provided funds -- matched by state and local sponsors -- that enable the MEP to extend its geographic reach. Thirty-seven of the NIST-managed affiliated centers were funded by the TRP. TRP also has provided matching funds for training modules, assessment tools, and other services that will help the individual MEP centers to deliver quality services to client firms. The MEP is now well positioned to carry on the work that has been jump started by TRP funds.

In January we announced a jointly funded initiative with the Environmental Protection Agency (EPA) to help smaller manufacturers become both more competitive and more environmentally conscious. The initiative will support the development of methods and approaches to integrate environmentally focused services into the portfolio of manufacturing extension center services. It also will support the development of new tools to help manufacturing extension organizations deliver these services to smaller manufacturers. In addition, we will support the establishment of industry-specific pilot centers.

MEP Impact

Our centers have been busy. They served nearly 9,000 manufacturers during the first three quarters of 1994, helping smaller manufacturers through hands-on assessments and advice, technology demonstrations, training, and seminars on specific manufacturing and business-related issues.

Surveys of our client firms are showing that manufacturing extension services are fostering significant improvements in manufacturing and business performance, yielding company-estimated benefits that greatly exceed the federal investment in the MEP. For example, during 1994, 610 companies returning surveys from 13 of our centers reported an economic impact of more than $167 million for technical assistance projects provided by MEP. Those impacts include changes in sales, capital spending and capital avoidance, inventory reductions, labor and material savings, and jobs created or saved. These results are consistent with our earlier evaluations.

The MEP is also sparking changes in the behavior of private and public-sector providers of extension services and advice. Federal support and access to a national network of supporting services is enabling previously existing, state-sponsored centers to extend their reach, develop new capability, and broaden the range of service available to companies. Moreover, private sector consultants are finding that, by working with the Centers, they have better access to smaller manufacturers as clients. A 1994 study found that MEP client firms are more aware of the competitive benefits of using modern technologies than non-client firms. They also are more likely to be planning to implement those technologies. More than 90 percent of the consultants surveyed said that MEP-assisted companies are more knowledgeable of outside consultants than firms that do not use extension services.

NIST LABORATORY PROGRAMS

NIST's laboratory programs have long been recognized for their practical assistance to industry and their focus on infrastructural technologies that support our economy. Our laboratory efforts are planned and implemented in cooperation with industry and focused on infrastructural technologies such as measurements, evaluated data, standards and test methods which provide a common language for use by industry in commerce.

Industry traditionally underinvests in the development of these infrastructural technologies because they are used simultaneously by many firms. These infrastructural technologies typically are not embodied in products, making it difficult or impossible for individual firms or even industries to recover the R&D investment it would take in order to develop these technologies. The benefits from this work are spread across many companies and industries, and the economic impact can be great.

The NIST laboratories operate with a customer base as diverse as U.S. industry itself. They include makers of one-of-a-kind scientific instruments, utilities that supply gas and electricity to tens of millions of commercial and residential customers, software publishers and computer manufacturers, aerospace giants, aspiring biotechnology firms, chemical and food processors, textile manufacturers, makers and users of machine tools, suppliers of steel and concrete, and designers of exotic new materials. Customers range from tiny start-ups to the "Big 3" auto makers and most other companies among the nation's top 100 R&D spending firms.

NIST Laboratories' Progress to Date

Appropriations for NIST laboratories have increased by 37 percent between fiscal years 1993 and 1995 -- the first significant increases for these critical efforts in many years. The attached chart (#2) clearly shows how this long-needed increase has changed the pattern of basically flat funding during the past several decades -- a period during which industry experienced dramatic technological growth and confronted NIST with a backlog of demands for our research and services. These are research and services that are not otherwise available to U.S. industry.

Despite early concerns that the new NIST extramural programs might detract from the traditional laboratory mission, we have ample evidence today that the new programs, particularly ATP, have strengthened our laboratory efforts on behalf of industry. This is reflected both in the increasing laboratory budget and in the reinvigoration of the labs' technical efforts.

These increases have permitted NIST to strengthen our core capability for infrastructural technologies. We have accomplished this without increasing our staff; those who were working to support other agencies' needs have shifted to NIST funding so that they may respond even more directly to industry needs. Also, planning is underway for the renovations and new construction that is vital if the labs are to meet industry's needs in the coming century.

I am particularly proud of three accomplishments:

- We have been able to more aggressively tackle industry's infrastructural technology needs in emerging areas of technology that have grown in the past decade. For example, two areas where we are bringing greater resources to bear in biotechnology and information technologies. Both are clearly huge growth areas for industry, and neither can move ahead easily without the kinds of underlying research and services done by the NIST laboratories.

- The underlying base for metrology, the science of measurements, has been revitalized. For example, our scientists recently trained an array of four lasers on cesium atoms, trapping and cooling them to within 700 billionths of a degree of absolute zero, the coldest temperature ever reported for an atom measured in three dimensions. This accomplishment eventually may lead to improvements in the accuracy of atomic clocks; each past improvement has led to almost immediate technological applications, from synchronizing telecommunications and electrical power grids to the Global Positioning System.

- We have broken through years of uneasy relations with our partners in the private sector voluntary standards community, forging new, stronger relationships and bolstering our own standards-related activities. This improved cooperation is critical in light of new international trade agreements and activities. Industry now can count on NIST to deliver more promptly vital standards-related information and services, and to be a better partner in representing U.S. interests in the international arena.

Our laboratories' formal linkages with industry remain as strong as ever. During the past year, NIST entered into 133 new Cooperative R&D Agreements, or CRADAs. Of NIST's 500-plus CRADA partners since 1988, 40 percent have been small businesses, 45 percent have been large or mid-sized firms, and 15 percent have been universities and other organizations. On average, one technical staff member in five is engaged in a CRADA -- just one indicator of industrial interactions.

NIST Laboratories' Impacts

Several hundred laboratory projects are under way at NIST during a single year. Some relate to the needs of mature industries. Others concentrate on technical challenges confronting emerging industries, and on established high-technology sectors undergoing rapid technological change. All are conducted with industry helping to set the priorities and guiding the work. Most are carried out with industry's active involvement.

Below are several typical projects that give a flavor of how recent NIST laboratory efforts have worked for U.S. industry.

- Faced with the imminent elimination of ozone-destroying chlorofluorocarbons (CFCs) and the phaseout of related refrigerants, the nation's $17 billion air conditioning and refrigeration industry now is using a NIST-developed database which calculates key thermophysical properties of 38 refrigerants and mixtures. In the search for cooling systems that are both environmentally and economically acceptable, industry needed high-quality data. An official of the Air-Conditioning and Refrigeration Institute, an industry association, says, "Without NIST, we would have gotten less detailed data, which would have meant a lot more expensive, time-consuming engineering work to produce hardware. It would have cost us millions more."

o A NIST tool for quickly evaluating the performance of coordinate measuring machines -- used by many manufacturers to check the dimensions of parts and assemblies -- is helping U.S. firms improve their quality assurance methods and cut costs. Manufacturers now can comprehensively assess CMM performance quickly, decreasing the chances that companies will ship poor-quality parts to their customers or scrap good parts mistakenly. Evaluated by Caterpillar Inc.

and Boeing, the NIST tool has been commercialized by Giddings and Lewis, a U.S. maker of these measuring machines and machine tools. The product was introduced last year, and already has markets in the aerospace, automotive and heavy equipment industries.

o NIST recently issued a standard optical fiber that is helping U.S. fiber makers to reduce product variability and greatly improve the likelihood that spliced fibers will align precisely -- ensuring the high quality transmission of signals that their customers expect. An official with Corning, Inc. reports that this capability has given "Corning and other fiber manufacturers a clear competitive edge."

NIST aims for and expects its infrastructural technologies and services to yield high returns since we expend resources only once to develop, for example, a measurement method that can be used by many companies and frequently for entirely different technologies. Results of an ongoing series of economic impact studies confirm those returns. To date, 8 economic impact studies have been completed, yielding a median rate of return of 167 percent. These returns compare very favorably with those reported in studies of returns on other public investments in technology and on private sector R&D investments.

For example, a recent study shows that through improved calibration services NIST has enabled a tenfold increase in measurement accuracy of watthour meters. In turn, that has allowed U.S. electric utilities to more accurately monitor more than $180 billion of electrical power generated annually, facilitating the resolution of disputes and generating a sizable return to U.S. taxpayers. A new analysis estimates that total benefits exceed costs by a ratio of 41 to 1.

NIST QUALITY OUTREACH PROGRAM

With the cooperation and financial support of the private sector, NIST manages the Malcolm Baldrige National Quality Award, which has become both the U.S. standard of quality achievement in industry and a comprehensive guide to quality improvement.

The award program was established by Congress in 1987 not only to recognize individual U.S. companies for their quality achievements, but also to promote quality awareness and to provide information on successful quality strategies. The major focus of the award is on results and customer satisfaction; it is not given for specific products or services.

NIST has worked closely with a variety of groups to extend the benefits of quality management and stimulate activities nationwide. These organizations range from trade, professional and business groups such as the National Association of Manufacturers, the Council on Competitiveness, and the U.S. Chamber of Commerce, to state and local government organizations and broad-based interest groups like the National Education Association.

Key to this program -- and indicative of its cooperative nature -- is the award's board of examiners. Made up of more than 250 quality experts from many industry sectors, along with a smaller contingent from universities and governments at all levels, board members volunteer many hours reviewing applications for the award. They have given more than 10,000 presentations on quality management and the award program, helping to spread the message and tools and techniques for improving quality management.

Quality Award Progress to Date

From 1988 to 1994, the award program received nearly 550 applications form U.S. companies. Twenty-two companies, including 11 large manufacturers, five service companies, and six small business have won the award. But the program is much more than a contest. Equally important is the award's role in raising awareness by encouraging all U.S. business and organizations to implement quality improvement efforts whether they intend, or are even eligible, to apply for the award.

About 1 million copies of the award's guidelines and criteria have been distributed by NIST worldwide, and thousands of organizations are using the criteria as a quality improvement road map. The results of these internal evaluations provide firms with a clear view of where they stand and of how far they must go to achieve world-class levels of quality.

Forty-two state and local quality award programs are operating in 30 states -- most modeled after the Baldrige Award. Many companies participate in these award programs before applying for the national award.

With experts from health care and education, NIST has adapted the Baldrige criteria and framework for these sectors and is launching a pilot program. Pending a successful 1995 trial, continuing support from these two sectors, and funding, full-scale award programs for education and health care could begin in 1996.

Quality Award Impacts

The Baldrige Award program is having a profound effect on how people and organizations operate and work. An independent 1993 study to determine what U.S. business thinks about the award indicated that both industrial and service firms -- large and small -- agreed that the award currently provides the best framework for a total quality management system. The results also showed that the firms surveyed believe the award fosters quality awareness, promotes the understanding of the requirements for quality excellence, promotes sharing of information on successful quality strategies, and recognizes U.S. companies that excel in quality achievement and quality management.

Preliminary results from a more recent survey of U.S. firms conducted last fall by the award's independent advisory group indicated similarly strong support. Seventy-one percent of those 52 companies responding said they used the award criteria as a quality management assessment tool, and 86 percent said that sharing of practices by Baldrige Award winners has helped to motivate improvements in their own businesses.

Good quality management is no guarantee of business success, but it can lead to outstanding returns -- both for individual companies and for the country. These returns are showing up in increased productivity, satisfied employees and customers, and improved profitability. Recent studies by NIST and others have found that a stock investment in the group of companies winning the award could result in large returns. For example, a hypothetical $1,000 was invested in the five whole company Baldrige Award winners from the first day the company won the award (or went public) to October 3, 1994. The investment yielded a 188 percent return on investment compared to a 28 percent return for the Standard & Poor's 500, outperforming the S&P 500 by almost 6.5 to 1.

CONCLUSION

The Administration and Congress have expanded the nation's investment in NIST over the past two years while the total level of federally supported R&D has been held steady, or even reduced slightly. The total investment at NIST remains a very small percentage of the government's R&D program. The added investment at NIST is designed to bolster the support companies receive from an agency that has a long track record of working directly with and for industry -- and delivering bottom-line value for taxpayers.

The priorities for our work are industry's priorities. We work in true partnerships with U.S. companies, small and large, to do the jobs that cannot be done separately.

Our major R&D funding effort, the Advanced Technology Program, is enabling technology development that is cost-shared, rigorously competed, and supportive of R&D work, always at the pre-product development stage.

By teaming up with state and local governments, our Manufacturing Extension Partnership is rapidly expanding services to smaller companies throughout the country.

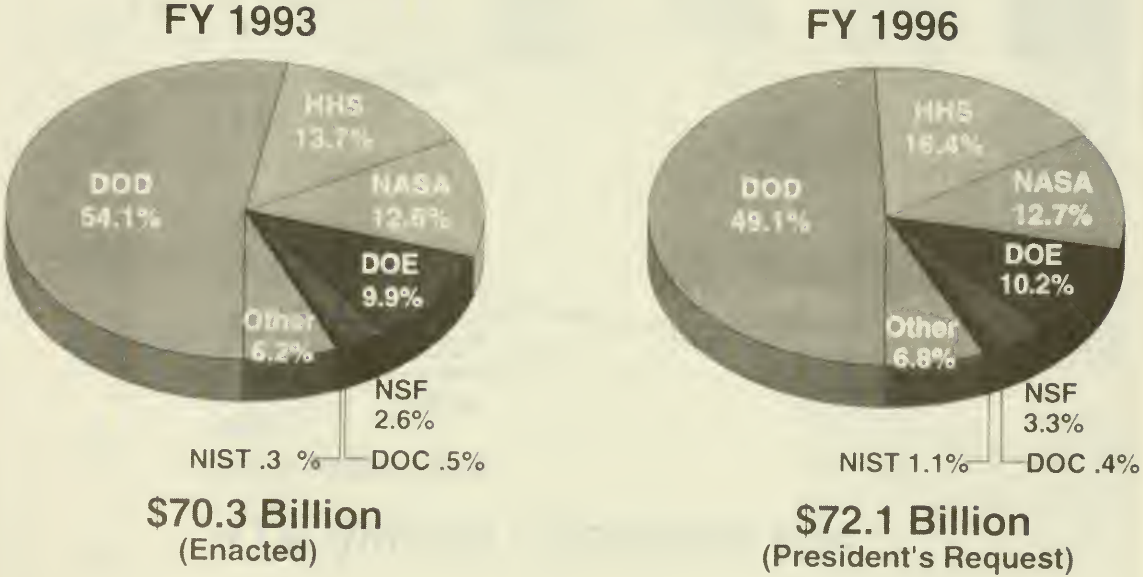
Our laboratories are offering industry the benefits of stronger measurement research and services that underpin companies' R&D, manufacturing and sales.

The Malcolm Baldrige National Quality Award program is beginning to extend the principles of good business practices to our education and health care sectors.

The scale-up challenges for our newer programs, the ATP and MEP, have been substantial. But we have had terrific engagement with industry in both cases. We have ensured that these programs are executed in a manner consistent with NIST's principles of technical excellence and objectivity. We are beginning to see the real fruits of this work, and we look forward to delivering even greater value and positive impacts for U.S. industry, our economy, and our taxpayers.

FEDERAL RESEARCH & DEVELOPMENT

Total R&D and R&D Plant–Outlays

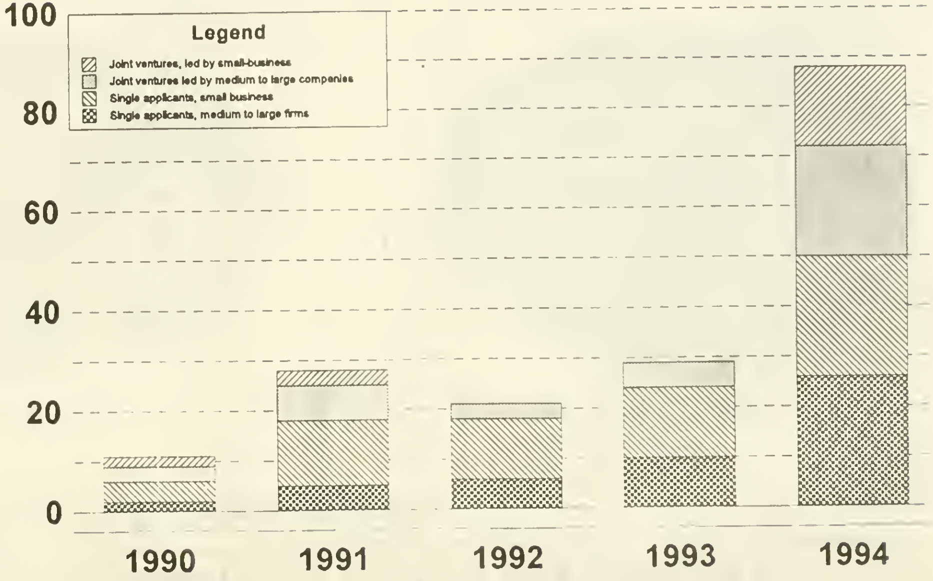


FY 1996 Budget of the United States

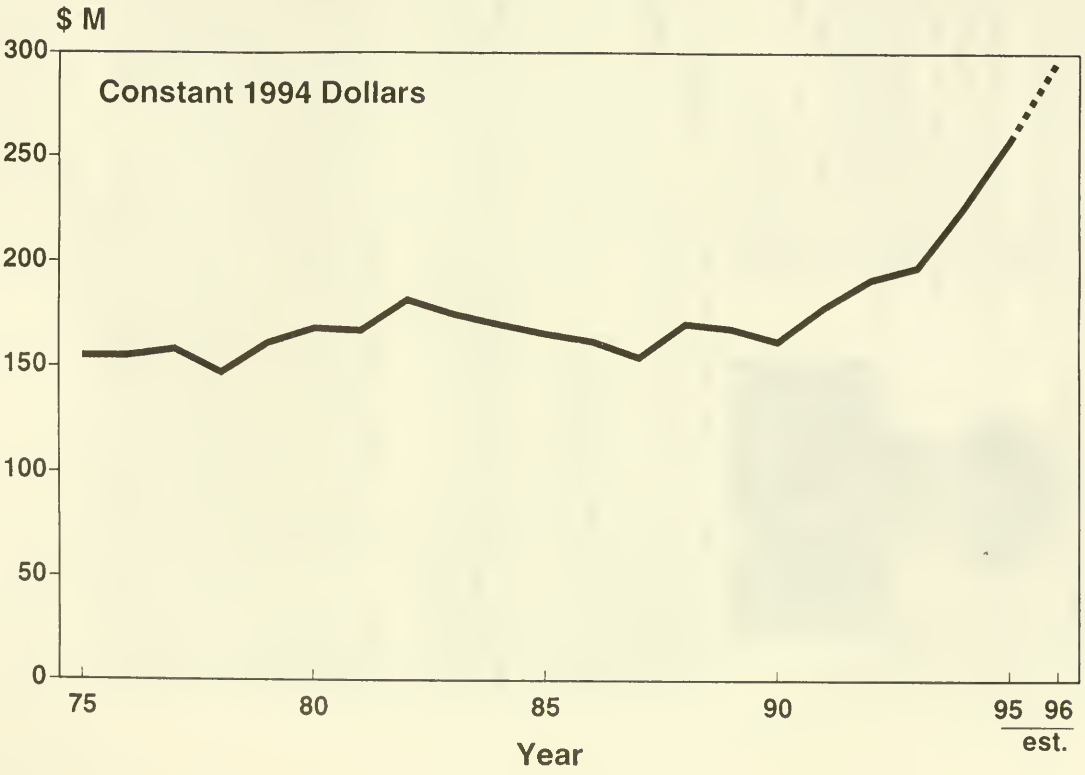
Attachment #2

ATP Awards - Business Mix

Ten Competitions



NIST LABORATORIES FUNDING



DR. ARATI PRABHAKAR
Director
National Institute of Standards and Technology

Dr. Prabhakar, appointed tenth NIST Director by President Clinton, took office May 28, 1993. An agency of the Commerce Department's Technology Administration, NIST promotes U.S. economic growth by working with industry to develop and apply technology, measurements, and standards. As NIST Director, Dr. Prabhakar oversees a staff of approximately 3,200 and a budget of nearly $1 billion. She manages a portfolio of major programs that partner with industry in the pursuit of technology for economic growth:

- a competitive Advanced Technology Program that provides cost-shared awards to industry for development of high-risk technologies with significant commercial potential;
- a grassroots Manufacturing Extension Partnership designed to help small and medium-sized companies adopt new technologies;
- laboratory research and services focused on "infrastructural technologies," such as measurements, standards, evaluated data, and test methods; and
- the Malcolm Baldrige National Quality Award and an associated quality outreach program.

Dr. Prabhakar currently chairs the Committee on Applications and Technology of the Information Infrastructure Task Force, which is studying how innovative technologies will help people do their jobs in new and different ways. The committee coordinates government-wide efforts to develop information technology applications and recommend technology policy in order to make the National Information Infrastructure a reality.

Previously, Dr. Prabhakar served for two years as Director of the Microelectronics Technology Office in the Defense Department's Advanced Research Projects Agency (ARPA), where she had managed advanced electronics research since 1986. She created the Microelectronics Technology Office to drive research, development, and demonstration of advanced microelectronics technologies critical to national security, with an emphasis on dual-use technologies. As Director of the office, she managed an annual budget of $300 million and contracts and collaborations with hundreds of organizations, including large electronics manufacturers, traditional defense contractors, small and medium-sized technology firms, universities, and other laboratories. Dr. Prabhakar had strategic responsibility for programs in semiconductor manufacturing technology, including SEMATECH and advanced lithography. The overall manufacturing programs were designed to stimulate and challenge the U.S. semiconductor industry to achieve cost-effective flexible manufacturing capability for high-value-added, differentiated products. Other areas of technology for which she was responsible included next-generation devices in optoelectronics, nanoelectronics, and neural networks as well as flexible manufacturing for infrared focal plane arrays.

From 1984 to 1986, Dr. Prabhakar served as a Congressional Fellow in the Office of Technology Assessment of the U.S. Congress where she wrote on microelectronics research and development for the House Science, Research and Technology Subcommittee.

Dr. Prabhakar is a member of Eta Kappa Nu, Tau Beta Pi, and a senior member of the Institute of Electrical and Electronics Engineers. She received a fellowship from the Bell Laboratories Graduate Research Program for Women.

Dr. Prabhakar was born in New Delhi, India. She received her B.S. in Electrical Engineering from Texas Tech University (1979), and her M.S. in Electrical Engineering (1980) and Ph.D. in Applied Physics (1984) from the California Institute of Technology.

10/3/94

Mrs. MORELLA. Thank you, Dr. Prabhakar.

I know that you have an extensive testimony that you submitted, and please know it will be a part of the record.

Dr. PRABHAKAR. Thank you.

Mrs. MORELLA. All the Members have looked at it.

I just want to ask each one question so I can give the subcommittee an opportunity ask questions, and then we may have another round, too.

Posing it to Dr. Good. How would you respond, Dr. Good, to the argument that competition in the global marketplace means that industries need to respond quickly, innovate continuously, which do not require Federal Government intervention?

For instance, we have heard from entrepreneurs in the past, and we are going to hear again today, that the best thing we could do to improve the business climate would be to implement product liability and regulatory reform, and provide tax incentives for patient capital and investment.

This is your opportunity now to respond to what we are going to hear.

Dr. GOOD. I am very pleased to respond to that question because my answer to it is.

They have to have all of these. If you read my testimony, we must have a business climate that is indeed conducive for people in these sorts of areas to do well.

On the other hand, if you look at the technology base in the United States, there really is I think a big misperception in part of this argument. That is, that the Federal Government has never played a role in technology development and the companies in the United States.

Nothing could be further from the truth. If you look at the total R&D budget in the United States, it is about 50-50 between the Federal Government and the businesses. Our businesses have benefitted greatly for many years from government policy.

We are really not talking about a total revolutionary approach to the world. The question is:

Should exactly the mechanisms that we used during the Cold War when defense was a big issue, should the mechanisms still be exactly the same? That really is the issue.

And, should a huge piece of our technology base be developed toward defense issues?

So my answer to that question is very straightforward. I do agree that we must do whatever is necessary to incentivize business development in the United States. That includes, however, a technology base on which those people can draw over time.

Today, in the last 50 years, we have built a big technology base. It was built by government funding to universities. It was built by government funding to mission agencies.

Many of our major industries were borne of technology development in the early 1950s and 1960s from the Defense Department that started whole industries like the aerospace industry and the electronics industry.

A good case in point. We are going to privatize this week I believe Internet.

There are those who believe that was started with private funds. It was started by the ARPANET, funded by ARPA, then funded by the NSF.

It is now being moved into the private sector, and the scientists are concerned because they do not know how they are going to get on, but they will have their own NET, it turns out.

NSF is going to continue to fund a network for scientific results.

But my point to you is that we have always had a partnership in a sense between the industry and the Federal Government on how we have provided technology bases.

Today the industry is spending only about 8 percent. The new numbers from the Industrial Research Institute is 8 percent in long-term R&D. That is down from 20 percent as little as 10 or 15 years ago.

The reason is the competitive pressures which they feel today and the rapid turn of technology products—the very short life-time of technology products.

A company today, in many industries, has to have technology going on in three products—the one they have on the street they have to service, the one they are going to peddle next year they have to get into the marketplace, and the one they are going to have ready three years from now they have to have in development.

That leaves little time or effort for long-term results.

We have always provided through the government mechanisms for long-term research. In a sense, that is what these programs are doing, but focused on the areas and with the—and to make it move faster, we think these partnership arrangements are much better than the old mechanism where we funded it within the Federal Government and let it spill over over time.

We cannot wait that long any more. If we put it together in partnership, we can move some of these fundamental ideas out into products very, very fast.

Mrs. MORELLA. I thank you for your answer.

Let me just ask Dr. Prabhakar before we move on. Because as we debate NIST programs, indeed it is important not to overlook the poor programs.

Dr. PRABHAKAR. Absolutely.

Mrs. MORELLA. I know that there have been a number of new initiatives within the laboratory. I just wondered if you might discuss very briefly the basic science and mission-related research which is being done there.

Dr. PRABHAKAR. Absolutely. I would be pleased to.

Let me just start maybe by commenting on three areas where I think we have been able to really revitalize and reinvigorate our laboratory activities in the last couple of years.

The first is that over many, many years of flat funding for our laboratories during decades while we were basically just trying to keep up, our industries were flourishing and growing, whole new industry sectors were evolving, and so we really are I think trying to address a backlog of needs in terms of measurement standards, valuative data, test methods, the job that the Nation's measurement laboratory is really supposed to do for our industry.

So one of our areas of advance I think has been our ability now to step up, particularly in information technology and biotechnology, to dramatically evolving new industrial areas.

I think we are building our capabilities there in a way that will serve those industries very well.

Secondly, we have been able to really charge up our basic measurement sciences. You can imagine that that science underpinning, the base upon which we build our specific activities for industries, that that is the kind of work that erodes with the kind of flat funding we have been dealing with for a long time.

So today we have got some new activities and I think a really charged up basic research activity that will position us to serve the industrial needs and infrastructural technologies in the future.

Third, and I think perhaps most importantly, is that we have created a very vigorous and positive new kind of relationship with the private voluntary standards system.

Our country is unique in the world in having a vigorous private sector driven voluntary standards system rather than a government-driven product operating standards system.

But we think that the previous relationships in that community have not been particularly healthy. We think that we needed to work in a much more collaborative way with the American National Standards Institute, with the many standards developers in the private sector, and with the other government agencies that care about standards issues.

I think that we have really turned that around and we are in a position to just be a much better partner now to that private effort.

I think all of those efforts are the result of the fact that our laboratories are I think—first of all, we have gotten the budget increases we are managing without staff growth, but by moving more of our people on to direct appropriated funds—but I think it is also part of the overall sense of energy and sense of purpose in the organization as our new programs have grown as well.

I think we see the synergy back and forth as the labs support, for example, ATP and ATP in turn gives the labs some new and exciting windows into the industry.

Mrs. MORELLA. Thank you for your response.

I am going to turn it over to Mr. Tanner now, but I wanted to recognize that we have joining us Mr. Brown, who is the Ranking Member of the Full Committee.

Thank you for being here. I think you said you did not want to add any comments at this point?

Mr. BROWN. No. Thank you.

Mrs. MORELLA. Mr. Tanner.

Mr. TANNER. Thank you, Madam Chair.

I want to follow up just a minute with Dr. Good on what she said, because I quite frankly could not have agreed with her more when she said we need all three. We need tort reform, product liability reform, streamlined government, but we also need I think some government involvement in helping bring technology that otherwise just simply would not be done.

With the unrelenting, unbelievable pressures on CEOs from Wall Street for quarterly reports, for yearly performances—otherwise, the stock may go down and you get—I have had a personal experience with that—with hostile takeovers then occurring, it is just unrealistic to think that American corporations and business can research a product that will not come to market for 15 or 20 years. They simply cannot afford to do it in this day's environment with the unrelenting pressure from Wall Street.

So to say that everything will be all right, just to wash our hands of it and turn it over to the marketplace I think would be shortsighted.

Let me ask you this, Dr. Good:

You have had great, wide-ranging professional experiences of professor, as head of research in a major corporation, now in the government. I would like for you to briefly capsule the changes—and you can do so better than I—but the changes you have seen in the business climate, and how companies perform this research and development so crucial to our Nation's industrial and technical future, technology future?

How has that changed over the last 20 years?

And how has our role as the Federal Government fit in, and what changes have you seen, and what could we do better?

Dr. GOOD. Thank you very much.

There have been major changes. I spent 15 years in the private sector just before coming to this job. One of the reasons I agreed to come to do this particular job—and I have to tell you that my people—my friends in the private sector still wonder if I have a sound mind for having made that decision—

Mr. TANNER. So do mine.

[Laughter.]

Dr. GOOD. —but I thought it was a time that we might be able to really begin to make the kinds of connections between the $70 billion that the government is spending on R&D, and make those connections to the private sector in a way that will be meaningful for our children and grandchildren so we have the same kind of high technology businesses and high-quality jobs available that we have today.

To be able to do that, we really do have to understand what has changed. It is really very significant.

In my 15 years in the industry, we changed from spending a reasonable amount of our R&D money in our central laboratories on relatively long-term work. My company, for example, had three or four major products that it had invented and brought all the way from the invention to the production stage and had been selling for 10 or 15 years.

We moved from a position of doing that—and it turned out we made a study one time of how long it took us from the time that the laboratory work was done and when we got our money back on those products—and in every one of those big cases—and the study ranged all the way from medium sized jet engines which we made to nylon sitix [phonetic], which is a big commodity resin material—in all cases, it was 20 plus or minus 2 years.

The problem is two fold today. With the kind of short-term pressures we have, we couldn't afford any longer to pay for a 20 year out program. So the issue was that to be competitive and to get our price down—because today's products sell on—there are really only three things that sell products today. One is the cost. It has to be cost competitive. It has to be quality competitive. And it has to be delivered on time. That is it.

It is time, cost, and quality.

To be able to do that and to compete, we had to move big chunks of our technology resources to how to make our product better, how to get the manufacturing costs down, and how to meet that competition.

So we moved from paying a fairly large amount on long-term things to a very small fraction. If you look across the country, that has happened across the board. Our technology pool in the United States was built not only by the universities and federal laboratories, it was also built by some absolutely fabulous central laboratories in this country.

The first one was General Electric. AT&T-built laboratories you know, and I will just finish.

All of those today are in the process of being funded by the business units. That money is now being spent not in those laboratories but at the business unit level. The rule is, if it is not being spent on a product that I can see coming to market within the next three to five years, you cannot have it in your budget.

That is the change.

If we do not use our federal money to fill that gap and to have these enabling and emerging technologies move into that product base very fast, other people will do it instead.

Because much of our technology base is available to us, but it is also available to anyone else who wants to mine it.

Mr. TANNER. Thank you. My time has expired.

Mrs. MORELLA. I would like to recognize the Vice Chairman of the Subcommittee, Mr. Calvert.

Mr. CALVERT. Thank you, Madam Chairman.

I suppose this question would be both for Dr. Prabhakar and for Dr. Good.

What is the maximum amount of ATP funding that may be awarded to an individual company?

Dr. GOOD. I will let Dr. Prabhakar—

Dr. PRABHAKAR. By legislation, there are two kinds of awards that are possible. Single company awards are capped at $2 million for the federal share.

Mr. CALVERT. On November 18th of last year, the Department of Commerce announced 47 winners of ATP. The winners included IBM, Westinghouse, Texaco, DuPont, Dow Chemical, Caterpillar, General Motors, Ford, Chrysler, Amoco, British Petroleum, Mobil, Exxon, Chevron, 3-M, United, Shell, TRW, Texas—and many other large companies.

According to Value Line, the R&D budgets for IBM last year was $6.8 billion.

Westinghouse, $175 million.

DuPont, $1.3 billion.

3-M, $1.1 billion.

What I am getting at, are you suggesting to the subcommittee that the companies with the R&D budgets of this magnitude, that $2 million to fund projects ostensibly critical to the future of their industry needs to be budgeted by ATP?

Dr. PRABHAKAR. Mr. Calvert, I think the point that we have been focusing on this afternoon is exactly what the nature of those investments are in companies of all sizes.

I think if you will look at where those companies are spending their dollars, you will find that in order to be more efficient in their investments, every year those companies are focusing on narrower, shorter term projects overall—I am speaking in an aggregate sense—and it is precisely for that reason that there are opportunities for that kind of longer term innovation even with companies of that sort.

I would also like to be very clear that it would also be possible to go through the list of awardees in ATP and I could name off for you 70 companies that probably you have not heard of because they are so tiny. And in fact, I think small companies participate very well.

Mr. CALVERT. Well, let me ask this question:

If those companies, including large and small companies, if they had a choice, what would you predict their answer would be. To continue an ATP program? or to have an R&D tax credit?

Dr. PRABHAKAR. I think that is an excellent question. In fact the answer is I believe that you are talking about an apple and an orange, and I think if you want to make fruit salad you better have all of the above.

What an R&D tax credit does is help companies pay for the R&D that they are going to do anyway. We have had an R&D tax credit in place for many, many years. So this is not a theory; this is just fact. That while we have had an R&D tax credit in place, there has been no evidence that industry is investing in longer term, riskier technologies. In fact, all the trends in the last several years have been quite to the contrary.

So an R&D tax credit is a very valuable tool. It is something that we have advocated for. But it does not play the same role that these kinds of investments play in terms of allowing us to go after the longer term, riskier activities.

Mr. CALVERT. How would you evaluate the success of an ATP program?

Dr. PRABHAKAR. I think that is exactly the right question. What I would like to back up and focus on is why are we making these investments? We are making these investments for the broad-based, long-term economic benefits that can flow.

So one part of the success of ATP has to do with the success of the ATP participants. We hope that they will take the technology advances and put their own funds into moving those technologies into the marketplace.

Mr. CALVERT. Is there any way to track that return on investment?

Dr. PRABHAKAR. Absolutely. And in fact that is part of our evaluation process.

Mr. CALVERT. Have we tracked that return on investment?

Dr. PRABHAKAR. Absolutely. We have in place a process that will track over the long term what those returns are. I want to be very clear that a program that started with $10 million in Fiscal Year 1990 will not show you the full-blown economic effects in 1995. We are not investing for that time scale.

What we can see today are the early results that tell us we are on track for the full-blown, down-stream benefits. Let me just give you some examples.

We have several cases where the ATP investment is with a small firm—usually a few entrepreneurs that have a concept. What we help them do with our cost shared funds is to get to the point of a prototype where they can then develop the market strategy, develop the commercialization linkages, the licensing agreements, and the strategic alliances.

So what we see today are new technologies that would not have existed any other way. We see the business relationships building to take those technologies into the marketplace, and we see the very early stage growth in these small firms.

And again I want to be very clear that that is not the full-blown benefit that we are making the investment for, but these are the early signs that we are on track.

Mr. CALVERT. I guess the point I am making, though, is that ATP in 1990 was $10 million. This last, or in this year the recommendation is for $491 million.

I am thinking about how do we keep track of whether these investment dollars work. I am aware that IBM Corporation, for instance, is working on the fifth-generation artificial intelligence computer, parallel processing—I am not the whiz some of these people here may be, but none of these were government guided.

The Japanese of course invested a tremendous amount of resources in government-guided programs that were a total flop. A total flop.

How do we know that ATP would have any more success than the Japanese Government had?

Dr. PRABHAKAR. First and foremost, these programs are not government guided.

Dr. GOOD. —are not government guided.

Dr. PRABHAKAR. We are on the same track here. I think that is a critical distinction.

Other nations around the world have undertaken to do these sorts of things. We have tried to learn from those models, but I do not think it is appropriate to plop into our society and our economy those same top-down approaches.

So I think a tremendous strength of the way we are going about doing this is, ATP is actually a platform that enables industry to go after the long-term projects. It is not something that instructs industry as to where it needs to make its investments.

I would also point out the specific example you mentioned in terms of artificial intelligence and parallel computing is actually an excellent example of some work that was seeded by very early stage R&D investments in the defense investment.

So I think you will find fingerprints from early government investments in many of those areas.

Dr. GOOD. In fact, may I just make a comment about that? You will not only find fingerprints, you will find huge federal fingerprints in that particular arena because the National Science Foundation even funded an engineering center in that arena, in which IBM was a major participant.

Mr. CALVERT. Thank you.

Mrs. MORELLA. Ms. Lofgren.

Ms. LOFGREN. Thank you.

The central purpose of ATP is to promote economic growth, as we have discussed, by helping in the long-term investment in high-risk technologies.

You have talked a little bit about beginning to do measurement, and I believe that is important. I agree with you that if it were looking at long-term investments, we will not see the results that are measurable in four years or five years.

But I am wondering if you can explain the methodology that you are using and the time frame in which you would expect we could see results with some examples of what you think we might find.

Also you mentioned the initial results that show us we are on the right track. If you could amplify that.

Dr. PRABHAKAR. I would be happy to, Ms. Lofgren.

I think my testimony lays out some of these elements. We try to evaluate the benefits that flow from the ATP investment. What we are really concerned with are those long-term, broad-based benefits, not just what happens in the ATP participating companies but in the broader—there are customers, for example, that are benefitting from their technologies.

To capture that information we have laid in place a process for gathering information after the period of the award. Because of course the ATP award is just cost sharing very early stage work that is followed by significant private investment.

We have tried to design it so that it is not burdensome for the companies, but so that we are able to get the information back to assess the taxpayer investment. I think that is working with the companies.

What we are focusing on right now, because the time frame at the moment is one in which we can only really evaluate in a quantitative way the actual near-term effects, and there first of all we are assessing the effectiveness of the program itself.

Is ATP a tool to increase research efficiency?

Is it a tool that is helping to create an opportunity for strategic alliances to do R&D, and then subsequently on their own dollars for companies to take technology to the marketplace?

And all of our survey results, independent surveys that have been done on the work that ATP is supporting, indicate that in fact all of those kinds of activities are happening.

I am also very instructed by looking at specific examples. Let me just mention one. We had an example of two entrepreneurs who had a concept for ion implantation. It was something in their heads and therefore too risky for private investment.

We did a very brief project with them that allowed them to get a laboratory prototype, and on the basis of that physical demonstration they now have in place at least one marketing agreement and one licensing arrangement for one application area—semiconductor manufacturing; and the promise of potentially some other applications in as different an area as medical imaging.

So I think this is an interesting example again of the enabling nature of the technologies we are supporting. That firm was 2 employees when we started working with them, and I believe they are about 35 employees today.

Most significantly, those are not 35 employees on taxpayers' dollars; they are there on private funds, because our project has been concluded.

Now the full-blown effects from that effort will come when the technology finds its way onto the semiconductor manufacturing floor and into medical imaging. That will take some years to happen, but I think we can see already today the market opportunities that that company is facing in its own growth, and I think that is a very important early sign.

Ms. LOFGREN. I would agree. And what I am wondering, I do think it is very important to measure what we do, because people always have questions—and properly so—and it is important to have answers.

How will we quantify when that technology makes it out generally the thousands, or hundreds of thousands of jobs that might be related to it, how will we track that and be able to let the taxpayers know that they have gotten their money's worth?

Dr. PRABHAKAR. Again, that process is in place with the information that we are prepared to collect from the companies. I think the time frame, just to use that example, I think it will probably be about another five years before you can start to see the pervasive benefit.

One thing I would just like to add onto that. If you look forward to some of the investments we are making today, I think one thing that is critical is when you make the investment it is important to see whether there is a dramatic opportunity ahead of you.

One example I would offer is that one of our focus programs in ATP is Information Infrastructure for Health Care.

If you consider the trillion dollars we spend in this Nation on health care, and the fact that 20 or more percent of that is spent on information processing, I think it is very clear that information technology, if you could create a seamless infrastructure of information, you could really start to take a whack at those several hundred billion dollars that are spent on information processing.

Now this is happening in islands. It is not happening yet in the sort of seamless way that it needs to happen. There are some technical challenges. There are a lot of business challenges.

We believe that the opportunity there is immense in terms of the many billions of dollars that could be saved. Those benefits will accrue in part to the ATP participants that are going to create those technology solutions, but the real beneficiaries are all of us that are part of that health care system—the providers, the consumers, et cetera.

I think that is a good example.

Ms. LOFGREN. If I may, I know my time is up, but I am wondering if later in writing you could give me some more information.

I think the reason, when I hear these kids today say, well, you know, the Internet, and they love it, but they thought it just happened, and they do not know the history of it, and they do not understand the federal involvement. I think it is important that we track the information.

So I would love to have more information.

Dr. PRABHAKAR. We would be pleased to.

[The information follows:]

March 1995

ADVANCED TECHNOLOGY PROGRAM (ATP)

INFORMATION INFRASTRUCTURE FOR HEALTHCARE

Supplemental Information for Program Competition 95-10

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Background

The U.S. healthcare industry stands at a critical juncture. While facing a significant increase in the number of customers who will need to be served, the industry is being tasked by the nation to increase quality of results, to ensure consistent quality between rural and urban providers, to be accountable for outcomes, to provide accurate measures of success, and to accomplish all of these with lower costs.

Information technology forms an important part of the solution. Accurate and up-to-date information is essential to continuous quality improvement in any organization, and particularly so in an area as complex as healthcare. However, information systems must enhance rather than hamper the role of healthcare providers. Furthermore, diverse information systems must be integrated across the healthcare enterprise.

The knowledge base in the medical field is large, complex, and growing rapidly. It includes scientific knowledge as well as familiarity with the day-to-day business of providing healthcare. Information scientists cannot hope to understand the medical users' complex needs in a short amount of time. Similarly, complicated information science techniques, such as rigorous requirements analysis techniques or systems which require a great deal of training, cannot be, and should not be, introduced into the already complex healthcare environment. With limited time and resources for both the nation and for individual participants, it is crucial to identify the processes in the healthcare sector that would most benefit from the support of information technology. A broad-brush approach could be extremely costly and could actually impede the progress of the healthcare industry.

Tools are needed to assist with broad and accurate knowledge acquisition from healthcare providers and to help determine the business case for reengineering and technology development. The tools produced by this program must help bridge the gap between the medical and administrative knowledge possessed by healthcare personnel and the information science knowledge possessed by technologists.

The Information Infrastructure for Healthcare focused program, managed by the National Institute of Standards and Technology's Advanced Technology Program (ATP), is based on advanced technology rather than on standards development; however, it will coordinate with and contribute to on-going standards development efforts related to healthcare and information science. The tools developed under this program will provide maximum flexibility for healthcare systems development. For example, the development of information brokers, which translate and transfer knowledge among many vocabularies, databases, and information systems, can enable interoperability of new and existing applications. This approach is based on defining common requirements, rather than imposing a common design. The subsequent utilization of the management tools developed under this program will help to define crucial areas where standards are needed, while eliminating the need for excessive standards development.

The program budget is estimated to be $185 million over 5 years. The private sector participants are expected to meet ATP matching fund and indirect cost requirements. Outyear funding is contingent on future appropriations.

Healthcare Program Description

The ATP healthcare program will develop automated tools to catalyze the development of the healthcare portion of the National Information Infrastructure (NII), referred to in this document as the National Healthcare Information Infrastructure (NHII). This infrastructure will enable enterprise-wide integration of information among all sectors of the healthcare industry.

Information infrastructure development involves both:

- the integration, synthesis, and definition of any information that needs to be shared across the enterprise, and
- the means by which to transport, store, and access that information in a way that enhances, rather than impedes, user productivity.

The ATP healthcare program will be accomplished with serial solicitations in each of three technology areas over the first 3 years of the program:

1. infrastructure development
2. user interface and efficiency enhancement
3. healthcare-specific applications

It is imperative that the infrastructure developed be driven by user requirements, rather than by the technology available. Experience in the software development industry has shown that purchasing hardware before considering how it will be used seldom satisfies real customer needs. In fact, one reason that automation has not been more widely accepted in the medical community is that its implementation often has been unwieldy.

This program enables technology development for an infrastructure in an area that is both critical to the nation and fraught with complexity. Both of these facts increase the risk of the venture, but also increase the expected contribution of a successful ATP program.

Technical Goals

To establish the technologies for:

- Reliable storage and retrieval of complex medical information for varied applications
- Real-time, data-driven medical decisions
- Real-time data entry by mobile medical personnel
- Real-time global transport of complex medical records with accuracy, speed, and security
- Computer-based medical training, diagnostic, and reference tools

Business Goals

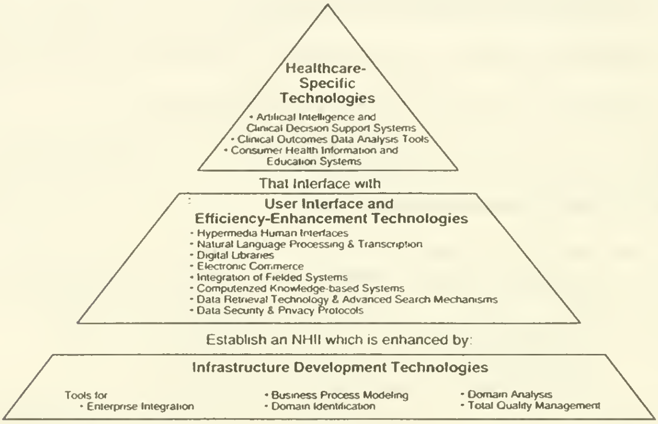
To gain the capability to develop products that will:

- Reduce unit healthcare costs
  - increase productivity of healthcare providers by shifting time from paperwork to patient care
  - shorten hospital stays; reduce outpatient visits per illness
  - decrease needless duplication of records through reuse
  - decrease duplicative and erroneous tests
  - improve financial and management information handling
- Improve quality of healthcare (higher treatment success rates and avoidance of complications)
  - improved patient monitoring
  - faster and more accurate analysis of data
  - faster delivery of treatment
  - more accurate diagnosis
  - reduced incidence of errors in tests ordered
  - remote and widespread access to expert medical advice and advanced diagnostic and treatment tools
- Capture global market share of new and improved products and services

Technical Ideas, Plan, and Program Structure

The rate-limiting step of information-related healthcare industry reform is integration and, right now, the industry is stymied at that step. Never before has an integration so massive and complex been attempted. Existing modeling tools, simulation tools, data management systems, search mechanisms and security measures cannot address a problem of the scope and breadth of the entire national healthcare industry. The ATP can provide critical leverage to develop the technology needed for an infrastructure that will meet or exceed user expectations.

The technical program encompasses three levels of technological advancement, as shown in Figure 1.


Healthcare-Specific Technologies
• Artificial Intelligence and Clinical Decision Support Systems
• Clinical Outcomes Data Analysis Tools
• Consumer Health Information and Education Systems
That Interface with
User Interface and Efficiency-Enhancement Technologies
• Hypermedia Human Interfaces
• Natural Language Processing & Transcription
• Digital Libraries
• Electronic Commerce
• Integration of Fielded Systems
• Computerized Knowledge-based Systems
• Data Retrieval Technology & Advanced Search Mechanisms
• Data Security & Privacy Protocols
Establish an NHII which is enhanced by:
Infrastructure Development Technologies
Tools for
• Enterprise Integration
• Business Process Modeling
• Domain Identification
• Domain Analysis
• Total Quality Management

Reference source paper PI930208

Figure 1. (Read from the bottom up)

The development of the envisioned infrastructure will be driven by the healthcare-specific technologies. These are the systems that directly address the problems of the medical user community.

The user-interface and efficiency-enhancement technologies are those that enhance the usability of the healthcare-specific technologies.

The infrastructure-development technologies enable the capture and organization of user requirements and varying forms of user information repositories. These tools will be used to develop the prototype information infrastructure and to maintain and enhance its functions as user feedback is obtained.

Thus, the medical user:

- sees and interacts with the healthcare-specific technologies
- appreciates the results of the user-interface and efficiency-enhancement technologies, but is not directly involved with them, and
- is completely unaware of the infrastructure development technologies in the day-to-day providing of healthcare.

The medical user may have only an indirect interaction with the infrastructure development technologies. Information scientists will use the infrastructure development technologies to gain knowledge from and interact with a representative sample of healthcare users in modeling the healthcare enterprise. These tools will help validate the completeness and integrity of the model for the infrastructure.

Thus, the healthcare users will see the infrastructure pyramid from the top down. However, the infrastructure developers will build the pyramid from the bottom up. The infrastructure development technologies will help to capture and synthesize the basic user requirements. The user-interface and efficiency-enhancement technologies will then add value and ease-of-use to the basic infrastructure. Finally, the healthcare-specific technologies will actually implement the users' functions using the enhanced infrastructure.

The first solicitation (94-04) was held last year and addressed the infrastructure development technologies. Technical challenges included:

- Business process modeling techniques, needed to provide formal procedures for defining and analyzing the relationships among all the processes involved in providing healthcare or in running a particular healthcare enterprise
- Total quality management techniques, needed to improve corporate performance, based on customer satisfaction
- Enterprise integration tools to translate information from multiple vocabularies and parts of the healthcare enterprise, to help users determine what information is needed, to facilitate information flow, and to enable electronic commerce
- Domain identification tools to help define criteria that truly identify a domain in a way that optimizes reuse, and domain analysis tools to acquire, organize, and model the knowledge about the processes in each domain and the rationale behind them
- Verification and validation tools

Sixteen awards were announced in October 1994 as a result of the first solicitation. Summary award data is shown in the table below. A set of abstracts describing these sixteen awards is included in this package.

94-04 Awards: Summary Data

Number of Awards	16
Single Applicants	8
Small Businesses	4
Joint Ventures	8
Small Business lead	2
Participants*	46
Small Businesses	20
Total Funds Committed	$148M
ATP Share	$72M
To Joint Ventures	56M
To Single Applicants	16M
Industry Share	76M
From Joint Ventures	60M
From Single Applicants	16M
States in which Participants are located	17

* Includes joint venture members, and excludes subcontractors, informal collaborators with joint ventures, and collaborators and strategic partners of single applicants

Table 1

This second solicitation (95-10) focuses on technologies and tools that will underlie and enable the development of applications for distributed, heterogeneous, multimedia-based healthcare systems. Proposed projects should expand the base of the infrastructure development technologies by providing the user interface to, or the efficiency enhancement of, the information infrastructure for healthcare. Proposed projects must fall into one or more of the following categories: (1) information access, transmission, storage, and retrieval technologies; (2) multimedia information technologies; (3) security and privacy technologies; (4) mobile and collaborative computing technologies. In addition to those types of projects listed in the middle section of the triangle in Figure 1, examples of specific advanced technology research topics included under each of the categories are as follows:

(1) Information access, transmission, storage, and retrieval

- o Advanced query languages and capabilities that provide location-independent access, anticipate users' needs and assist the user in formulating precise requests
- o Interfaces capable of adapting to user preferences, limitations, and behavior
- o Mechanisms for effective information filtering
- o Techniques for optimizing searches of large, mobile and distributed information resources, including capabilities for time-critical delivery of data and for handling conflicting responses or out-of-date data
- o Digital libraries that support the above capabilities

(2) Multimedia information
- Information capture and generation, including automatic feature abstraction and indexing for retrieval
- Representation of multimedia objects, including modeling of the relationships and coordination between multiple streams, and semantics-based compression schemes
- Information management systems that deliver multiple data streams in an integrated fashion with guaranteed time constraints and support content-based queries

(3) Security and privacy
- Core security services (confidentiality, authentication, access control, integrity, non-repudiation, logging and audit)
- Methods for designing, building and maintaining scalable, secure systems
- Mechanisms for security management across network and enterprise boundaries

(4) Mobile and collaborative computing
- Wireless components and systems technology, including protocols for mobile networks
- Universal connectivity, including concurrent communications and efficient information dissemination methods
- Robust security systems and compression technology for wireless transmission
- Low-cost, non-volatile storage with fast access, high data rates and low power requirements for geographically dispersed and mobile databases[1]

It is understood that some technologies proposed may fall into more than one category. Also, this representative list is not meant to be exhaustive. Research proposed under this solicitation should be tailored to the requirements of the healthcare information infrastructure but should be applicable to other infrastructure domains as well. All relevant system requirements should be addressed, including elicitation of user requirements, data integration, interoperability, scalability, security and privacy, system performance, and ease of use.

The third solicitation, to be announced next year, will address healthcare-specific technology challenges including artificial intelligence and clinical decision support systems, clinical outcomes data analysis tools, and consumer health information and education systems. Demonstration projects will lead to integration and commercialization of the various technologies.

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[1] Technologies included in this list are representative of those suggested by white paper submissions from industry as well as recommendations taken from R&D for the NII: Technical Challenges, edited by Mary Vernon, Edward Lazowska, and Stewart Personick, published by Interuniversity Communications Council, Inc. (EDUCOM), 1994. Many thanks and acknowledgment to the members of the program committee, the track chairs, and the participants who played a role in the workshop and the ensuing writing of this report.

U. S. Economic Benefit

According to the Health Care Financing Administration, medical spending in 1994 exceeded $938 billion. That means that one out of every seven dollars spent in the United States is on healthcare. Only a few decades ago, health and education consumed equal amounts of the U.S. GDP; now the amount for healthcare is more than double that for education. There are 6,500 hospitals and 700,000 doctors in the U.S. When analyzing the workforce, we see that one in every 11 people is in the healthcare business. Take Pittsburgh, for example, where 25,000 work in the steel industry, but 106,000 work in medicine. Likewise in Houston, where 66,000 are employed by the oil industry, but 110,000 by the healthcare industry.[2]

Indeed, the healthcare industry has a pivotal role in the economic health of our country. The United States has long been the recognized leader in providing high quality innovative care. We have been the pioneers in life-saving advances such as bone marrow transplants and coronary artery bypass surgery. We have developed advanced diagnostics and therapeutic products, which in themselves form an important export industry with significant growth potential. (For example, U.S. exporters control half the world's $71 billion medical device market.) Medical technology is the fastest growing sector of American exports.[3] Nonetheless, we are all aware that runaway healthcare spending is slowly eroding the competitiveness of U.S. companies and straining the U.S. government. The industry has had difficulty in reducing operating costs and increasing productivity.

The healthcare industry is not integrated in its information management. Patient information is often inaccessible at the time healthcare decisions are made. Healthcare professionals spend valuable time looking for records, calling each other for basic information, or repeating tests because previous test results could not be found or obtained quickly. It has been estimated by the Parkview Episcopal Medical Center, Parkview, Colorado (July 1994) that physicians spend 35 percent of their time and nurses spend 50 percent of their time on paperwork. A recent study performed by Ira Magaziner, Senior Advisor to the President for Policy Development, confirmed that nurses are so burdened with administrative costs that they spend more time with paper than with patients. Data are not readily available to evaluate and compare alternative treatments and interventions on an ongoing basis.

According to Dr. William Tierney, Professor of Medicine at the Indiana University School of Medicine and one of the lead authors of several Journal of the American Medical Association cost/benefit studies, "This is the most expensive industry in the country, and everything is done on paper. We've got to get away from that."[4] Donna Ganzer of the American Hospital Association has described the industry's data collection mode as "collect many times, use once." It must move to "collect once, use many times." In addition to the healthcare provider, information is used by government agencies, payers, and researchers. These users must depend on a limited set of data, often not transmitted in electronic form, or wade through perhaps hundreds of pieces of paper to locate the key information required. This is not only unwieldy but raises confidentiality issues. Computerized access could make it easier to obtain the needed data while at the same time controlling release of what data is supplied to whom.

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[2] Fortune, May 17, 1993.

[3] Ibid.

[4] InfoWorld, February 15, 1993.

This program addresses the innovation and reengineering of the information technology related to the medical facility and delivery system. Today the infrastructure is fragmented, each institution having a unique set of diagnostic systems, internal data formats, patient record systems, and communication and computer networks. This lack of an adequately developed infrastructure is a cost barrier, discouraging commercial companies from advances in this area. There are also high technical risks in the systems engineering to ensure reliability, availability, maintainability, data integrity, and the high level of confidence needed to make data available for every patient 24 hours a day, 365 days a year. This program will provide evolutionary changes and advances in information technology applied to healthcare that will change and improve the delivery of care and will reduce care costs. With estimates that a minimum of 15 to 25 percent of today's healthcare costs are related to the processing of information, the economic benefit of such a program is clear.[5]

Although there are many barriers to collecting cost-benefit information, and it is difficult to obtain reliable figures to evaluate the overall cost-effectiveness of contemporary systems, evidence exists that shows partially automated systems can be cost effective. For example:

o A randomized controlled clinical trial conducted by Tierney and others at Regenstreif Institute of Indiana University showed significant cost savings associated with physician use of microcomputer workstations for writing all inpatient orders. For teams using the workstations, the average total charges were $887 per patient lower (12.7%) and the average length of stay was 0.9 day shorter.[6]

o Using microcomputer workstations to present physicians with previous test results reduced the number of tests ordered by 8.5 percent and reduced the dollar cost of testing by 13 percent per visit.[7]

o When physicians at a primary care facility were informed of fees for outpatient

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[5] Medical Economics, October 23, 1993.

[6] Tierny, W. M., et. al. Physician inpatient order writing on microcomputer workstations: Effects on resource utilization. JAMA. 1993 Jan. 20. 269(3):379-383.

[7] Tierney, W. M., et. al. Computerized display of past test results. Annals of Internal Medicine. 1987 Oct. 107(4):569-574.

- A recent case study, supported by the Agency for Health Care Policy and Research in the Public Health Service, looked at a comprehensive hospital information system in one hospital in California and compared it with systems in two other hospitals. This original system was installed in 1975. Now, almost twenty years later, the hospital continues to outperform comparison hospitals in all financial indicators. It experiences shorter patient stays and lower costs per admission.[13]

Healthcare is the fastest growing market in the computer field. Medical software systems have uses including the monitoring of patients, tracking financial information, and collecting and analyzing data from medical instrumentation. Sheldon I. Dorenfest & Associates, Ltd., estimates that hospitals will spend $6.7 billion a year on information systems in 1996, a 36.7 percent increase over 1993. Computer companies are taking note. Hewlett-Packard, the world's largest medical equipment maker, has established a healthcare group. Ben Holmes, manager of this group, expects the market for healthcare information systems to reach $13 billion by 1998.[14] Estimates for needed hardware for this industry also show growth. According to Dataquest, Inc., the worldwide market for computer systems dedicated to medical applications reached an estimated $610 million in 1993, an increase of nearly 10 percent over 1992. Assuming constant growth, it is reasonable to extrapolate that the 1994 market reached approximately $670 million. By 1996, worldwide sales are expected to reach more than $800 million.[15] An ATP program would accelerate the growth rate of both computer hardware and medical information systems used in the healthcare industry.

In addition to the economic benefits discussed above, there are qualitative benefits, including:

- better quality of care
- more efficient patient care management (fewer lab tests, shorter hospital stays)
- dramatic improvements in productivity and job satisfaction within the healthcare industry
- education and preventive care (with major implications for cost reduction in the billions of dollars)

A 1988 Rand study found that one out of every five patients admitted to a hospital is either wrongly diagnosed or treated. The Institute of Medicine reports that: 11 percent of laboratory tests must be re-ordered because of lost results; 30 percent of the time, the treatment ordered is not documented at all; 40 percent of the time a diagnosis is not recorded; 30 percent of the time a medical record is completely unavailable during patient visits. Better care can also diagnostic tests by ordering tests through a microcomputer workstation, the number of tests decreased by 14 percent and charges to patients decreased by 13 percent or $6.68 per visit.[8]

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[13] Kunitz and Associates, Inc. Draft Final Report (December 1993).

[14] Arnst, Catherine and Wendy Zellner. Hospitals attack a crippler: paper. Business Week February 21, 1994, pp. 104-106.

[15] U.S. Industrial Outlook - 1994.

- A quantitative and qualitative assessment to determine the value of the pharmacy module of the HELP automated medical record system showed that the system yielded a 3.94:1 benefit/cost ratio from avoiding complications due to drug interactions.[9]

The above examples provide evaluations of specific systems. There have been a few attempts to estimate more broadly the costs and benefits of information technology advances in this area:

- Projections anticipate a savings of $45 billion from implementation of even the most basic administrative enterprise-wide healthcare system, with savings in such areas as reductions in repetitive testing, less paperwork, identification and earlier treatment of diseases.[10]
- A study by Health and Human Services estimates that a nationwide electronic healthcare information network could provide a savings exceeding $100 billion over the next eight years, with over half of the savings attributed to reduction in the number of diagnostic tests ordered, increased efficiency, and shorter hospital stays.[11]
- Telecommunications applications would be expected to save $36.6 billion annually through:
    - more efficient management of patient information ($30 billion savings)
    - faster and more efficient processing of the more than four billion claims, 90 percent of which are now processed as paper submissions ($6 billion savings)
    - improved inventory management ($600 million savings)[12]

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[8] Tierney, W. M., et. al. The effect on test ordering of informing physicians of the charges for outpatient diagnostic tests. New England Journal of Medicine. 1990 May 24. 322:1499-1504.

[9] Gardner, R. M., et. al. Assessing the Effectiveness of a Computerized Pharmacy System. Proceedings of the Fourteenth Annual Symposium on Computer Applications in Medical Care. Los Alamitos, CA: IEEE Computer Society Press, 1990.

[10] American Hospital Association, December, 1993.

[11] Department of Health and Human Services. Savings from the Medical and Health Insurance Information Reform Act of 1992. Washington, DC, October, 1992.

[12] Little, A. D. Telecommunications: Can It Help Solve America's Health Care Problems? Cambridge, MA. July, 1992.

lead to cost savings. For example, mistakes in prescribing medicines add $3 billion a year to the national health bill. Tests at the Latter-Day Saints Hospital in Utah showed that in determining appropriate medication, a doctor was 60 times more accurate when using a computer system than when only paper records were available.[16]

Industry Commitment

Today the healthcare community encompasses much more than hospitals, doctors, and the insurance industry. The healthcare industry impacts employers, communities, state governments, telecommunication operators, providers, patients, payers, service coordinators, financial services, regulators, and vendors. The healthcare community is at the threshold of spending billions of dollars on new information technologies. In the past two years, several large consortia have been formed to address parts of the long-term, national interoperability issues surrounding the development of an information infrastructure: the Computerized Patient Record Institute; MCC's Healthcare Open System Trials program; and the National Healthcare Industry Consortium. Participants in these consortia represent well over 50 percent of the healthcare community. Included are physician and dental organizations, nursing organizations, hospital organizations, health informatics organizations, medical record organizations, employers and businesses, managed care and insurance organizations, healthcare facilities, and vendors of technology. Activities of these consortia are funded through membership dues and newsletter subscriptions.

This ATP focused program is based on white paper submissions from approximately two dozen companies and consortia. On February 4, 1994, a steering group met at the National Institute of Standards and Technology (NIST) to plan an ATP-sponsored workshop in this program area. The steering group consisted of twelve industrial representatives who had submitted source documents and two representatives from other government agencies. At a workshop on February 23, 1994, industrial support was evidenced by an attendance of over 400 representatives.

Industry commitment is also evident from the funds presently being allocated. In 1993, hospitals and providers spent approximately $12 billion for research and programs related to the healthcare information infrastructure. Insurance companies, payers, and Health Maintenance Organizations also spend appreciable funds. Approximately $400 million to $500 million is expected to be spent on research and development in medical informatics a year.

In this program area, funding is needed to develop the foundation for a NHII, namely, to accomplish the development of a national reference architecture and some representative enabling technologies. Members of the consortia listed above have been and are willing to at least match funding for this technology development with the federal government.

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[16] Arnst, op. cit., pp. 104-106.

Will ATP Make a Difference?

The development of the technology needed to establish the long-term national vision of an interoperable, highly complex and dynamic information system is too costly and too risky for even a group of companies to fund. The technical resources needed to tackle the problem are diverse. Consortia are being formed, as discussed above. Industry has begun to build relationships with state and local governments. The health reform plans being discussed in many states call for powerful information solutions. These groups need the information technology developed under a partnership program such as the one described here. Individual hospital systems are being developed on a micro-level, without knowledge of how to make the most out of communications through the NII. Individual institutions are developing specific technologies. For example, Dr. Paul Clayton, Director of Medical Informatics at Columbia Presbyterian Hospital in New York, reports the development of automatic warning labels on packaged products and database linkages. ATP can serve as the catalyst for bringing the various healthcare projects and sectors together. Without the catalyst provided by ATP funding and activity, true collaborative networks will be delayed for a number of years. Additionally, the development of an NHII is a high-risk and long-term venture. ATP can minimize the individual risk so that investments can be made in the long-term issues needed to accelerate a NHII and a NII.

The Computer Systems Policy Project is an affiliation of chief executive officers of American computer companies which develop, build, market, service, and support information processing systems and software. This group "recommends implementing a joint public-private sector effort to significantly increase the information technology investments made by major healthcare stakeholders, to accelerate nationwide deployment of a healthcare information infrastructure."[17] The cited report from this organization asserts that the Center for Healthcare Information Management has also recommended developing cooperation mechanisms for the government and industry partners to share in the costs of development and implementation of needed technology. To date, though, "questions remain regarding how to fund its widespread implementation and the cost savings that are possible from such implementation."[18] An ATP program can provide this mechanism.

Similarly, Marilyn Cade, Director of Technology Infrastructure, Computer Products and Services for AT&T, testified on behalf of the National Healthcare Industry Consortium before the Senate Subcommittee on Science, Technology, and Space (August 5, 1993). She stated that development of a healthcare information infrastructure is a task "which requires a partnership between government and industry. No single firm or group of firms have found themselves able to produce [the shift to a new healthcare information system] alone." Relevant issues include not only cost, but market uncertainty and significant technology challenges.

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[17] "Information Technology's Contribution to Health Care Reform," CSPP.

[18] Ibid.

Other government agencies are investing in information technology applications in healthcare. But the money flows almost exclusively to funding either strictly basic research, or to solving low-risk, near-term problems directly related to the mission of the funding organization, or to establishing small, isolated pilot projects using existing technology. The ATP focused program in this area is unique in providing long-term funding for high-risk projects, led by industry with the motive of economic benefit to the United States.

The healthcare industry is at a critical time in development, and today's decisions will set precedents for future generations. New projects funded through this second ATP focused program competition will:

- lower risks involved in development
- provide long-term funding
- accelerate development
- reduce potential for closed systems
- reduce possibility of market domination by a small number of companies
- increase entry for small- and medium-sized companies
- lead to improved medical care and lower costs

Conclusion

The long-term vision and impact of this ATP focused program is clear: despite the significant increase in the number of customers who will need to be served, the healthcare industry will achieve an increase in the quality of results, consistent quality between rural and urban providers, accountability for outcomes, and accurate measures of success. All this may be accomplished with lower costs. The driving force behind these advances is the development of open, interoperable, yet secure systems - systems that will provide the medical community with the capability to integrate diverse information and business systems as well as the data necessary to support continuous quality improvement. Through enhanced user interfaces the real needs of the healthcare providers will be met, improving the information aspects of long-term care, preventative care, inpatient care, elective surgery, and home care for patients ranging from prenatal to geriatric.

Advanced Technology Program

U.S. Department of Commerce

Technology Administration

National Institute of Standards and Technology

ATP FOCUSED PROGRAM: Digital Video in Information Networks

FY 1995 Funding: $15 million
Estimated FY 1995-2000 Funding: $120 million

Potential for U.S. Economic Benefit. From the early days of noisy teletype interfaces to Rolling Stones concerts "broadcast" live on the Internet, digitized graphics have become an ever-more-sophisticated element of information networks. They are an increasingly important component as well. In business communications, scientific visualization, and user interfaces—to mention only a few areas—graphics have become an effective method of organizing and presenting information on complex concepts and relationships.

Moving pictures—known as digital video in this context—are the most exciting and demanding of these graphic formats. As computers become multimedia workstations, as television moves to high-definition digital formats, and as telephony takes on elements of both, information technologies are merging together in unprecedented ways. The industries that are creating information networks fully expect digital video to be an essential element of this convergence. And they anticipate huge annual markets for digital video—in the range of hundreds of billions of dollars—for phone, pay-per-view movies, home shopping, financial, educational, and other services that will include a video component.

The commercial stakes could hardly be larger. The overwhelming economic benefits from genuinely interoperable digital video technology stem from expanded and more attractive capabilities and services on the user end of the information framework. The broad user categories of entertainment, manufacturing, education and training, and health services alone account for several trillion dollars of commerce. Another set of industries that distribute information and make, sell, and integrate network equipment accounts for another few hundred billion dollars of economic activity.

Technology Challenge. Crucial technology decision points regarding convergence and digital video are arriving with disconcerting rapidity. One of these that industry has identified centers on precisely how video-based information will be digitally packaged and distributed in an information network in which the producers of the video products, the distributors of the information, and its users all employ a diversity of processing, transmission, and receiving components. The ideal is that any video-based information product—whether it be motion pictures, television programs, computer games, or home-shopping systems—can travel via wire, optical fiber, satellite, or broadcast seamlessly into regular TVs; high-definition TVs; computer monitors; and other information appliances at homes, factories, hospitals, and schools.

The three major industry groups of the emerging and relentlessly growing information network—the creators of information products such as movie houses, the distributors of the information such as cable companies, and those who make appliances such as TVs with which users access the information—recognize that they are at a particular decision point whose outcome will take them down very different paths. On the one hand, they can work cooperatively toward building a seamless information framework based on the "interoperability" of the framework's many components, a decision that raises the water level for everyone since it will enable a more attractive and versatile portfolio of services that will make the difference in the marketplace. On the other hand, they could allow the swift momentum of information technology to sweep them forward (or away) individually without full regard for the rest of the framework. In that scenario not only would the potential versatility of the emerging framework be clipped severely, but industry fears it would be virtually impossible to reverse.

To develop truly interoperable digital video capability across future information networks means creating R&D structures under which distinctly different industries with different histories, technology bases, and approaches to standards development can work together toward the goal of interoperability between and among network components. Individual companies already have begun facing challenges such as finding means of greatly compressing the enormous amount of data that video information requires while maintaining data quality and remaining cost-effective. Under the ATP focused program, many companies will be able to coordinate their efforts so that the collective outcome will be far more valuable for everyone on all sides of the information network.

Industry Commitment. Industry recognizes that the information networks that are evolving will be characterized by a convergence of different media such as telephony and video through the same diverse set of information network components. At a workshop in August 1994, 430 participants representing TV networks, telecommunications industries, and information technology companies convened to clarify the technology needs to be addressed if they are to build maximum value into the information networks. As a result of this workshop and a series of other industry-led gatherings, NIST received over 40 white papers from industry directly related to digital video. All participants identified the need for a long-term program involving both industry and government to facilitate development of interface standards, address intellectual property rights, support R&D in interoperable systems, and establish pilot programs to apply advanced video technology. This ATP focused program will fill a critical gap in the R&D part of this agenda.

Significance of ATP Funds. This is a now-or-never opportunity to include interoperability in the information network; once individual players establish themselves with their own protocols, others will have to either conform, bail out, or in the worst case, make way to foreign providers of more interoperable services. The ATP focused program in digital video in information networks provides a rare patch of common ground—a patch that relevant industry groups have indicated is badly needed—on which many companies devoted to different components of the emerging information network can gather, develop teams as needed, and plan interoperability of digital video into the ever evolving and converging network. The cost-shared program also can help accelerate development of relevant technologies or open doors to higher risk projects that would remain on companies' wish lists, particularly those of the smaller entrepreneurial variety where some of the more powerful ideas arise.

For information about eligibility, how to apply, and cost-sharing requirements, contact the Advanced Technology Program:

(800)-ATP-FUND [(800)-287-3863]
e-mail: atp@micf.nist.gov
fax: (301) 926-9524
A430 Administration Building
National Institute of Standards and Technology
Gaithersburg, MD 20899-0001

For technical information, contact:
Hanafy Meleis, Program Manager
(301) 975-5497
e-mail: meleis@micf.nist.gov
fax: (301) 926-9524

Mrs. MORELLA. And, Ms. Lofgren, there will be a second round, too, if you would like to pose it at that time.

I am happy now to recognize Mr. Gutknecht.

Thank you.

Mr. GUTKNECHT. Thank you, Madam Chair.

I would like to focus and sort of follow up on what Representative Calvert was talking about.

In the last week and a half or so, or maybe before then, some of our friends on the left have been accusing us of defending corporate welfare. I have been looking at some of this information before me and, as a matter of fact, as I understand it there was an announcement made back in December for a motor vehicle manufacturing technology project, as well as a materials' processing for heavy manufacturing totalling about $400 million—I think it was $185 million for one, and $145 for the other.

In regard to the motor vehicle program, General Motors, Chrysler, and Ford have been steadily increasing their domestic market share.

As a matter of fact, I think recently at least two of them have announced record profits. I am wondering how the Administration can defend giving these large subsidies to relatively profitable companies that are in the process of reinventing their manufacturing process anyway. And, is this really necessary?

I mean, these guys seem to be able to take care of themselves.

Dr. PRABHAKAR. I would like to tell you specifically about what that motor vehicle manufacturing technology program will focus on.

The first thing that is critical is to recognize that the participants in that program will largely be the smaller suppliers that feed into motor vehicle manufacturing.

What we hope to accomplish in that program is to lay the technical ground, the bases in technology that would dramatically change that industry's ability to introduce new products.

Right now if you look at the amount of time and the capital investment in bringing a new product into full production, those costs are staggering and they are a dramatic inhibitor of the kind of behavior that these companies need to be able to have—in order to respond to the rapidly changing marketplace.

That is not really something that the big three auto manufacturers can do by themselves, because it is so rooted in the process technology, the process equipment, that they purchase from many, many smaller firms around the Nation.

Dwight Carlson, who will be testifying on the second panel, I think would be an excellent person to ask the same question of since he represents one of those small supplier firms.

But again I think we need to recognize that none of our companies, small or large, are operating in a vacuum. They are operating in a system of connections and interfaces, and so much of the critical innovation really happens at those interfaces.

That is part of what a program like this can enable. I think that is why it has tremendous value.

Dr. GOOD. Can I just add one thing to that, particularly in the automotive industry?

As you know, one of the issues in automotive manufacturing today is how much American content is in those automobiles for which those profits are realized.

We need to make these small companies who have been suppliers for the U.S. automotive business, they now have to be absolutely as competitive as the big three. This program is primarily designed that they will be competitive, not the big three per se.

Mr. GUTKNECHT. Well, do we take it then that the Administration will come aggressively in to defend some of these corporate programs?

Dr. GOOD. Absolutely.

Mr. GUTKNECHT. Thank you.

Mrs. MORELLA. Thank you, Mr. Gutknecht.

I just wanted to pose just another couple of questions to Dr. Prabhakar particularly, because you are requesting $70 million for construction funding.

Dr. PRABHAKAR. Right.

Mrs. MORELLA. I have always been of the belief that construction funding, while it is for bricks and mortar, actually relates in reality to mission related research because of the laboratory facilities that are in desperate need of renovation and replacement.

I just wondered if you might want to comment on this need for construction funding and its importance to the NIST mission?

Dr. PRABHAKAR. Thank you very much for that chance to comment about the construction funds. This is part of a multi-year appropriation that began I believe in Fiscal Year 1992 or 1993.

The purpose is precisely as you stated, to create the laboratory facilities that will allow us to serve some of the very stressing measurement technology needs.

Our facilities in Gaithersburg and Boulder were built may decades ago. At that time, they were quite capable of serving some of the more aggressive laboratory requirements. But today, particularly in terms of vibration isolation and temperature stability, we really do not have the capabilities we need when we are trying to push state of the art in terms of measurement technology.

So those funds go to a renovation for several of our laboratories that exist today, to building a couple of new facilities as well where we will have not just world-class, but in fact the best-in-the-world capabilities in terms of vibration isolation and in terms of temperature control.

I think that is going to be a critical resource for us just simply in order for us to be able to do our laboratory mission in measurement sciences.

Mrs. MORELLA. And it is important to remember the relationship between the two. And, I guess if I have another moment here, in previous years NIST has indicated the need for flexibility to hire the best and brightest.

I serve on the Civil Service Committee also and have been looking at employees, too.

To help promote that goal, that NIST Personnel Demonstration Program was created. Could you briefly comment on whether or not it has been a success?

Do you think it should become permanent?

Dr. PRABHAKAR. The answers are “yes” and “yes.”

Dr. GOOD. Yes.

Dr. PRABHAKAR. I think, first of all, when I arrived at NIST I had served as a civil servant for many years in the Defense Department. It was a tremendous shock and a pleasure to discover that you could actually behave in a way much more like the private sector behaves in terms of recruiting the best talents.

That flexibility that the Personnel Demo project has given us is absolutely invaluable. We simply could not be meeting our requirements and building the kind of staff we need to have without that. So I think that has been critical.

From a management point of view, when we have surveyed the folks in our organization the very clear message that comes back is, yes, this is a much more sound, and a sensible, and a sane way to do business.

As you know, that project has a temporary lifetime. It is scheduled to end at the end of this calendar year. We are in the process of working with the Office of Personnel Management and are hopeful, and I think quite optimistic that we will be able to get an extension.

But in fact it really needs to become permanent. I think it is an excellent practice.

Mrs. MORELLA. I hope the subcommittee can help in that regard.

Dr. PRABHAKAR. We would very much appreciate that.

Mrs. MORELLA. Because from what you have said, and what I know about, it appears to be something that is really a model for others to follow.

I am going to now yield again to Ms. Lofgren.

Ms. LOFGREN. Thank you, Madam Chairwoman.

You know, I would say that almost all of the feedback I have had from Silicon Valley companies has been positive about ATP, including large companies that will never have an award, but they see that their vendors will and that it is good for the Valley and good for the economy of the country as well.

Nothing is perfect, however, and I think none of us want to just defend the status quo. This is not meant to be a highly critical question, because it has not been posed to me as highly critical, but there seems to be some view that—and this may just be the natural tension between business and government—that there are bureaucrats in Washington and business people out in the field—and I am wondering if you could tell us anything about the background, sort of following up on the Chairwoman's question, of the people who are involved in the program and their capability based on their background to deal with the business issues and whether you think that needs to be improved in the future.

And if so, how we plan to do it.

Dr. PRABHAKAR. I would be happy to try to respond to that.

First of all, I think the key issue in ATP is to make sure that it continues to be as private-sector driven as it possibly can be. I would submit that it is the most private-sector driven of any of our technology programs across the government.

One part of that is that we are designing the program to have a very lean staff at NIST.

For example, today the staff in the Advanced Technology Program is about 50 full-time folks. Our whole organization is about

3200. So I think that gives you a sense of how lean that organization is, because the dollars go out into the community. They are not there to build the bureaucracy at NIST.

Equally important is who those 50 people actually are. I think we have had some tremendous success in recruiting some people with excellent private sector backgrounds. If you look at our program managers today, we have, for example, a fellow that come to us from Digital Equipment Corporation. He had run a subsidiary of Digital and is an expert in network technology. He really knows that community.

The fellow who runs our software program, ran a software company himself before he came and joined NIST.

We have a woman who is a chemical engineer who worked at Shell Oil before she came on board and is now working extensively with the chemical manufacturing community.

I think that is just a brief indication of the kind of expertise we have been able to draw—in part because of our ability to recruit, I think, through this federal demonstration project for our personnel.

But that is central to the success of the program.

Ms. LOFGREN. I guess the other question I have, if my time has not yet expired, is that there have been some who I think philosophically have concerns or object to this whole scheme and initiative to jump-start and keep our economy moving.

Underlying some of that, at least as best I understand the criticism, or the objection, is that we would pick winners or losers in some manner.

I am wondering if you could tell us a little bit about the eligibility requirements and how you go about selecting an awardee.

Dr. PRABHAKAR. Absolutely. I would be happy to.

First and foremost in ATP, the process begins with industry. The process begins with ideas coming in from companies or joint ventures led by companies. So every dollar we spend is on a project that begins with an idea in industry. I think that is vital, so you will not see anything where we made up the answer and instructed someone what to do.

The evaluation process focuses on technical quality of the proposal and business quality in the context of how well does the proposal grasp what it will take to take this technology downstream into the marketplace.

Because we are not just investing for scientific knowledge in this instance, we are trying to make sure we build a bridge to the point where companies can make their own investments.

The evaluators of those proposals include some government technical experts, but we also draw on a few hundred private experts. We are very concerned about conflict-of-interest. We obviously cannot have a situation where your proposal is being evaluated by your competitor, but we are able to draw on people who have backgrounds in venture capital, have business degrees, have often just recently retired from companies where they made those kinds of technology and business decisions and have had that kind of hands-on expertise.

I think in a process very analogous to the National Science Foundation's peer review, we are able to get that private-sector input to guide the evaluation process.

Then, the final step I think is the fact that the work, when the awards are made, the work is done in companies. I think this is—I think there was a time in this country in the cold war era that when we had a national problem we created a national laboratory to go tackle it.

I think this program really begins with the understanding that the work needs to be done in the places that are capable of carrying the technology forward on their own investments downstream.

Dr. GOOD. Could I just add one quick thing to that?

In my view, one of the major pluses to the ATP is one which is not a hard metric, and therefore it is difficult to measure it, but the call for getting the industry in to talk about what the areas are that are really emerging today, where they can really think they could make a difference, getting them in to talk to each other and to discuss between small companies and big companies, and to have the kind of conversations that they have when they make the recommendation of what the focus programs are, creates as much intellectual fervor as almost the program itself.

But unfortunately that is a rather soft metric and it is very difficult to capture it. But in terms of value to the infrastructure of the country, it is my view that that may very well be as big as some of the hard metrics we want to measure over time.

Ms. LOFGREN. Thank you.

Mrs. MORELLA. Thank you, Ms. Lofgren.

I would like to turn again to Mr. Gutknecht for the second round of questioning.

Mr. GUTKNECHT. I will pass.

Mrs. MORELLA. I would like to recognize Ms. Seastrand for any comments she would like to make.

Mrs. SEASTRAND. Not right now; thank you.

Mrs. MORELLA. Thank you.

I would like to request, then, as we terminate this first panel, Chairman Walker has requested that he be able to submit questions both to you, Dr. Good, and to Dr. Prabhakar.

So on his behalf, I would ask unanimous consent that the questions be submitted into the record for response.

[No response.]

Mrs. MORELLA. Hearing no objection, the Chairman's questions will be submitted.

[The material referred to follows:]

Response to Questions from Chairman Robert Walker

Question 1

OMB's Circular A-130 and the recently adopted Paperwork Reduction Act of 1995 set out important guidelines for agency information dissemination activities including specific practices from which agencies should refrain, including prohibiting agencies from imposing royalty fees or charging more than the cost of dissemination for the information they provide. Does the National Technical Information Service (NTIS) abide by the principles of the Circular and the Paperwork Reduction Act? More specifically, does NTIS engage in either of these copyright-like practices? Does NTIS limit its charges to the cost of dissemination? How does NTIS determine the cost of dissemination?

Answer

The National Technical Information Service abides by the principles of Circular A-130 and the Paperwork Reduction Act.

In the case of the direction in Circular A-130 to "set user charges for information products at a level sufficient to recover the cost of dissemination and no higher," NTIS sets its user charges only to recover its operating costs and no higher. NTIS, taken as a whole, is an information dissemination system, and the cost of maintaining that system, including the maintenance of its permanent repository of historically important scientific and technical information and implementation of its modernization plan, is all that it attempts to recover.

In the case of the Circular's instruction to "avoid establishing restrictions including the charging of fees on the reuse of Federal information dissemination products," all Government publications sold by NTIS are free of any reuse restrictions in the U.S. Any citizen in the U.S. is free to obtain a single copy of any Government publication and to reproduce and sell it. Even the information contained in the NTIS bibliographic database that NTIS leases in its electronic form is produced in paper each year and provided to the 1400 Depository Libraries at no cost to those libraries. There are no restrictions on its reuse.

Question 2

In at least two publications of the National Technical Information Service (NTIS)--the 1992 two-year business plan and the 1993 joint venture guidelines--NTIS made reference to exclusive contracting arrangements that could be entered into with private sector joint venture partners. Exclusive arrangements for the use of taxpayer-funded information pose the danger of instituting a monopoly provider of this information in direct contravention of OMB Circular A-130, the Paperwork Reduction Act, the First Amendment and common sense. What type of exclusive arrangement was NTIS alluding to in these two publications? Do any such exclusive arrangements exist?

Answer

The National Technical Information Service has a clear policy prohibiting the granting of exclusive rights in the United States to any information generated by the Federal Government. Our joint venture guidelines cited in your question go on to state: "Such information must always be in the public domain domestically."

When NTIS enters into an agreement with a private sector partner, we do so with the expectation that the private sector partner will add value to some collection of Government information, and that NTIS will disseminate that value added product and revenues will be shared. Typically, potential private sector partners seek some protection for their packaging investment and often inquire as to whether NTIS would enter into the exact same arrangement with a competitor on the same core information. NTIS' policy is that we may enter into an arrangement to develop a different product from the same information or develop a similar product from an entirely different information set, but that we will not agree to duplicate their efforts with another partner. In effect, the exclusivity resides in the value added by the private sector partner, not in Government information.

Question 3

Congress, as a condition of awarding NTIS an $8 million appropriation last year, mandated that NTIS complete a proposal describing the delineation of responsibilities of both NTIS and GPO relative to the American Technology Preeminence Act. What proposals did NTIS recommend? How does NTIS propose to eliminate any duplication?

Answer

The report language accompanying the $8 million appropriation to the NTIS Revolving Fund called for NTIS to submit plans to Congress on how NTIS intended to use the funds and to coordinate those plans with GPO to ensure that NTIS was not duplicating any GPO mandates. The plan was coordinated with GPO and their concerns were included in the final report, a copy of which is attached. NTIS has no issues of duplication with GPO with respect to the American Technology Preeminence Act (ATPA). All reports submitted to NTIS under ATPA are available for sale to the public from their permanent repository. GPO may at its own discretion choose to make a limited number of high sales volume documents available while supplies last. GPO has no permanent repository responsibility and only takes about 12,000 inventory items compared to 100,000 new items per year at NTIS.

Question 4

Is the National Technical Information Service (NTIS) providing its bibliographic database via the internet at no cost to the Depository Libraries? If so, how can NTIS justify charging a substantial fee and royalty payment for the taxpayer-funded database to private sector users who are taxpayers?

Answer

The NTIS bibliographic database consists of over two million products. NTIS provides the Depository Libraries with online access only to products added to its collection in the last 30 days, or about 10,000 records at any one time. This enables them to identify those Government publications that are not printed through GPO and which have escaped GPO's document capture mechanism. Such documents are often referred to as "fugitive documents."

The NTIS database is not merely an alphabetical listing of titles and authors in NTIS' permanent collection. NTIS assumes significant costs in developing and maintaining its database in a format that is useful to researchers, including costs associated with abstracting many of the submissions, but receives no appropriated funds for this purpose.

The current system assumes that vendors will recover their own costs by charging their users. Thus, the costs are borne by those who derive the most benefit from it.

Question 5

Does the National Technical Information Service (NTIS) consider all the taxpayer-funded information it is collecting and disseminating "scientific, technical and engineering" related? How does NTIS make this determination?

Answer

The National Technical Information Service considers virtually all the taxpayer-funded information it is collecting and offering for sale to be "scientific, technical or engineering" related. NTIS has followed GAO's formal opinion that the term "technical" as used in the NTIS legislation includes "economic information, market information and related information so long as it is reasonably specific and bears some direct relationship to the organization and operation of industrial or business enterprise."

Question 6

Is the National Technical Information Service (NTIS) marketing itself to agencies as an alternative Freedom of Information Act (FOIA) fulfillment body? The FOIA requires that requests be fulfilled at the cost of dissemination and allows agencies to waive fees in certain situations. Is NTIS meeting these requirements? Is NTIS providing a mechanism for waiving fees?

Answer

NTIS provides no FOIA services to agencies with respect to their internal records, such as memoranda, findings, and procedures. It will assist agencies in responding to requests for information products that were produced for public dissemination and that are in NTIS' collection. The Freedom of Information Reform Act (Public Law 99-570) amended FOIA to clarify that FOIA fees are superseded to the extent that fees are chargeable under specific statutory authority (5 U.S.C. 552(a)(4)(A)(vi)). OMB has issued guidance to Federal agencies providing that (1) when documents responsive to a FOIA request are maintained for distribution by an agency according to a statutorily based fee schedule, requesters must obtain the documents from that source and pay the applicable fee in accordance with such other statute, and (2) the fee schedules maintained by NTIS and GPO as well are statutorily based within the meanings of FOIA (52 Federal Register 10017-18). Although the NTIS fee structure does not have an explicit waiver mechanism, any requester can file a FOIA request direclty with the originating agency and can request a fee waiver.

Question 7

Over the years, NTIS contracts with redisseminators of information appear to have gone from straight-forward, short contracts to very restrictive and copyright-like license agreements. What is/was the rationale for this change?

Answer

The National Technical Information Service contract agreements for the use of the NTIS bibliographic database has changed to reflect evolving requirements and practices in the information technology arena over the past 20 years and dramatic changes in the way people acquire, use and disseminate information electronically. Our current agreements follow the Information Industry Terms and Conditions (1990) and Guide to Database Distribution, published by the National Federation of Abstracting and Information, NFAIS, a well-respected national membership organization. The changes NTIS has made to its agreement have focused on the need for ever-increasing contractual clarity in a rapidly changing technological environment. Rather than being highly restrictive, the current NTIS agreement clarifies and expands upon the opportunities for use of NTIS databases.

UNITED STATES DEPARTMENT OF COMMERCE
Chief Financial Officer
Assistant Secretary for Administration
Washington, D.C. 20230

NOV 21 1994

The Honorable Peter Domenici
Ranking Minority Member
Subcommittee on Commerce,
Justice, State, the Judiciary
and Related Agencies
Committee on Appropriations
United States Senate
Washington, D.C. 20510-6025

Dear Senator Domenici:

Pursuant to the Conference Report 103-708 accompanying the Commerce, Justice, State, the Judiciary, and Related Agencies Appropriations Act, 1995, Public Law 103-317, enclosed is the requested reprogramming proposal which describes (1) how the $8 million appropriated to the National Technical Information Service (NTIS) to implement the American Technology Preeminence Act (ATPA) will be used, and (2) the delineation of the responsibilities of NTIS and the Government Printing Office (GPO) relative to the ATPA. This proposal has been coordinated with representatives of the GPO.

Thank you for your continued interest in and support of the programs of NTIS and the Department of Commerce. I am available to answer any questions you may have regarding this proposal.

Sincerely,

Thomas R. Bloom

Enclosure

One Time Capital Investment for The National Technical Information Service

Introduction

In House Report 103-708 the House and Senate conferees on the Departments of Commerce, Justice, and State, the Judiciary, and Related Agencies Appropriations Act, 1995, requested (1) a description as to how $8 million appropriated to the National Technical Information Service (NTIS) to implement the American Technology Preeminence Act (ATPA) will be used, and (2) a delineation of the responsibilities of NTIS and the Government Printing Office (GPO) relative to the ATPA.

The Director and Deputy Director of NTIS met with the Superintendent of Documents and the Director of the Federal Depository Library Program (FDLP) on October 21. Their discussion centered on NTIS' Depository Library 30 day preview file of current documents received by NTIS under the ATPA. This online file is designed to enable the libraries to identify all Government publications received by NTIS under ATPA that were not printed though the GPO or otherwise made available to the FDLP. This is the type of documents that the library community refer to as "fugitive documents." NTIS agreed to cooperate with the Superintendent of Documents to ensure that any selection by, or distribution to the depository libraries of any such "fugitive documents" would be done through the FDLP which is managed by the Superintendent of Documents under the authority of Title 44 of the United States Code. NTIS also agreed to cooperate with them on developing some type of automated profile search system that would be comparable to, and compatible with, the current FDLP system.

Section 108 of the ATPA requires all federal agencies to transfer to NTIS in a timely manner all unclassified scientific, technical and engineering information resulting from federally funded research and development activities. The final rule establishing the transfer procedures for agencies and any contractors and grantees authorized by the agencies became effective on February 1, 1994. NTIS' collection already contains more than 2.5 million documents dating back to the early 1920's and will become more comprehensive than ever before as a result of this mandatory deposit process. NTIS must therefore rely on modern technology to efficiently process the ever increasing volume of input in widely diverse formats and to make it available in whatever form that private sector customers demand.

Section 506 of the ATPA directed NTIS to report to Congress on the feasibility of establishing a comprehensive online inventory and authoritative register of Federal information products. It also directed NTIS to promote the production and dissemination of information products in electronic format as part of its statutory mission to implement new methods and media for the dissemination of scientific, technical and engineering information.

FedWorld, the NTIS online information system, was established in November, 1992, as a laboratory prototype to test whether public support existed, without which economic feasibility could not be demonstrated. NTIS' report to Congress in April, 1993, demonstrated that such support would depend on the ability of customers to connect to the system, the quality and timeliness of the information they found once they did, and their ability to acquire or order such information immediately and in the format they wanted. NTIS has continued to expand FedWorld's capabilities because of (1) its overwhelming public acceptance; (2) its effectiveness as a medium for electronic communication as contemplated by the ATPA; and (3) its usefulness for forging relationships with agencies that can add to its inventory.

NTIS estimates that the potential is there within two years to increase the capacity of FedWorld to enable 9 million customer connections annually. One of FedWorld's many unique features is its free service as a centralized gateway to over 300 Federal online systems, which callers can access with a single phone call or Internet connection. As agencies begin to take advantage of sophisticated software packages such as Mosaic to make their online offerings more attractive and easier to use, we expect public demand for one-stop access to increase dramatically - and certainly faster than NTIS can satisfy solely using its retained earnings.

The appropriated funds will be used for two main purposes. One is to support NTIS' ability to convert information from the various formats in which it may be received to the medium and format desired by a customer. The other is to increase the public's ability to connect to FedWorld and be served by it, whether using a simple personal computer and telephone modem, a commercial packet switching service, or the Internet.

NTIS has had a long tradition of serving the needs of information consumers even when the activities have not been in its own economic interest. It maintains a permanent repository of Government documents with full access through its sales program. Even though it is required to be self-supporting, NTIS provides free access to FedWorld and carries information on FedWorld that enables consumers to obtain information from sources other than NTIS, including GPO. FedWorld can also be used by agency producers of non-technical information to communicate directly with their public.

Technological advances in telecommunications and computers are rapidly expanding the public's ability to access information instantaneously and are making it more difficult to define, much less preserve, longstanding organizational distinctions regarding information management and dissemination. The Electronic Information Access Enhancement Act (EIA) and ATPA broadened the roles of GPO and NTIS, respectively. Technical distinctions between online information that can be obtained through FedWorld, on the one hand, and GPO Access, on the other, are fruitless and tend to diminish the friendly competition necessary to encourage the managers of the respective systems to generate creative improvements. In fact, even though NTIS has an explicit mandate for the dissemination of Government funded scientific, technical and engineering information, it has never claimed or expected exclusivity in this role. Instead, NTIS works to maintain its position in the market through high customer service standards and quality products. Rather than try to distinguish NTIS and GPO on the basis of types of information, a better distinction is that NTIS has had a long tradition as a comprehensive clearinghouse and developed and manages its online system in that capacity.

Investment in Electronic Information Handling and Dissemination

The American Technology Preeminence Act (ATPA) requires the transfer of all Federally produced or financed unclassified technical information to NTIS for dissemination to the public. ATPA will increase document input to the NTIS permanent repository from 90,000 titles where it is today to over 150,000 titles annually. Seventy percent of all documents input into the NTIS system are currently received from the originating agencies on microfiche. About 29 percent are received on paper and about one percent are received in various electronic media. Current trends suggest that within five years, these figures will be reversed. By the year 2,000, electronic formats will dominate. Unfortunately, the formats used by Federal agencies will probably not be standard.

Currently, NTIS fulfills demand orders using photocopying processes to reproduce documents from paper or microfiche originals. Document reproduction from paper or microfiche is no longer the most cost effective method to respond to a demand order for a single copy or a few copies. The process is simply too labor intensive; the original document must be retrieved from shelf storage, checked to ensure correct pagination, set-up on the photocopying equipment, and returned to storage when the job is completed.

In order to reduce the labor costs associated with the current manual production system and to meet the challenges of changing customer requirements, NTIS has developed a new, fully automated information system. The new system is able to receive information in any of the current common media, forms or formats and process that information into any desired media output format. As media and formats change, the open system concept designed into the NTIS Automated Document Storage and Retrieval System (ADSTAR) will enable NTIS to respond.

The NTIS ADSTAR system is a distributed network of high speed information processing equipment and software, operating as a system to efficiently manage and disseminate documents. The new system has been implemented on a pilot basis over the past two years from NTIS' own earned revenues, and has demonstrated the feasibility of electronically receiving, storing, retrieving, and reproducing information in a way that is format neutral. It is capable of reproducing the information in a format convenient to the customer including the electronic transmission to remote locations on demand. Handling costs have been dramatically reduced for the orders fulfilled through ADSTAR. Document quality is improved and time required to fill customer orders is significantly reduced.

The current system is capable of scanning and retrieving only about 15,000 paper reports per year. To meet projected demand, a full scale production system will be developed which will be capable of handling about 150,000 documents per year in various media and formats -- a tenfold increase in capacity. The appropriated funding will be used to capitalize NTIS' investment in the new equipment, software, and facilities necessary to expand the existing system into a full production multifaceted information system. The full system will also be capable of efficiently transmitting single documents via Internet or other high speed communications channels to remote sites for photocopying and delivery at customers' locations.

NTIS uses proven, commercial-off-the-shelf hardware and software to avoid incurring high development costs and to avoid the risks involved with implementation of unproved technology. The ADSTAR system is open and scaleable and is designed to incorporate new and developing technologies without major system changes. ADSTAR is integrated with the NTIS Order Processing and Bibliographic system in a manner that allows changes to one without disruption to the other. The ADSTAR system accommodates NTIS' unique repository function for U.S. Government scientific, technical, and engineering information by providing for the efficient fulfillment of single copy requests on demand. ADSTAR offers significant opportunities to reduce on-demand document production costs and to improve document quality and order fulfillment times, all critical NTIS goals.

Input Processing. NTIS has made significant productivity gains in abstracting and indexing incoming materials. However, the increased input expected as a result of the ATPA requires even greater productivity gains. If NTIS is to handle the increased volume with no increase in people, NTIS must rely on technological solutions. NTIS plans to invest roughly $750,000 in the hardware, software enhancements and network enhancements for machine assisted abstracting and indexing. Rather than reviewing paper documents, NTIS will rely on scanned images for input processing where the conversion to machine readable characters can be accomplished through automation.

Conversion. NTIS has developed an automated system for converting, in all media and formats, documents into a standard electronic image format that is essentially format neutral. However, the system is incomplete and requires considerable expansion if it is to be used to convert all documents NTIS receives into a common electronic denominator. NTIS will invest roughly $850,000 in scanners and digitizer to create compressed images of paper and microfiche documents. An additional $550,000 will be invested in optical character recognition technology to convert compressed images into character based files. This in-house conversion capability is essential if NTIS is to respond quickly and efficiently to customers' information requests.

Capacity and Management. At the present time the NTIS system for managing the electronic collection is relatively small since NTIS has a limited scanning capacity. As the volume of scanned materials increases tenfold, additional hardware and software will be required to manage the electronic collection. To support the conversion process, $850,000 will be invested in the software and network enhancements necessary to manage the large volume of information processed by NTIS. The enhancements will include disk arrays, electronic juke boxes, increased band width, increased capacity to receive information electronically and computer hardware and software to manage large volumes of electronic images and data.

Delivery. Although NTIS currently is capable of delivering documents in virtually every medium and format, technology is needed to upgrade all the various systems to meet industry's expanding need for immediate delivery. Enhancement to NTIS's information delivery capability will include $550,000 to upgrade all the various systems for producing information from tape duplication to CD-ROM production. Product delivery channels will be enhanced with the investment of $400,000 to develop the broad band communication channels necessary to deliver information directly to the customer.

Investment in FedWorld: A Comprehensive Source for Government Information Online

FedWorld is an online information dissemination service which provides public electronic access to technical and other information on behalf of agencies throughout the U.S. Government, in line with NTIS' mission and in support of the goals of the National Performance Review and the National Information Infrastructure. FedWorld's electronic clearinghouse is distinguished from NTIS' more traditional clearinghouse roles of document collection, storage, and delivery, by its gateway service, which allows customers to seamlessly connect to over 300 online services throughout the Government (including 120 other bulletin board systems); by its focus on the current, time-sensitive information; and by providing information dissemination services to other agencies under the Economy Act. FedWorld is also related to

NTIS' traditional clearinghouse functions, in that FedWorld functions as a means for customers to locate and order NTIS documents online, and in some cases to receive those documents within a few seconds of ordering them.

FedWorld already supports information dissemination requirements of programs in nearly every Cabinet agency, as well as the National Performance Review, the Office of Management and Budget, the Securities and Exchange Commission, and other executive branch agencies. Positive responses from the public and from agency program managers have generated a flood of interest. Pressure on agencies to cut back on staff and yet provide better customer service, more timely information, and more information in electronic formats has led numerous agencies to approach FedWorld as a cost-effective means to meet NPR and program goals. As a result, a major new initiative is underway in support of the Internal Revenue Service, and FedWorld is working with other agencies to support government procurement functions, electronic access to personnel information and other time-sensitive and high-demand government services.

It has been a key tenet of FedWorld's operating philosophy that the customer's technological platform should not preclude them from accessing government information. Too many government information systems exclude whole classes of citizens because of the limitations of the agency's technical platform. FedWorld allows public access from a variety of platforms: citizens may dial up directly using a computer and a modem; they may come in through the Internet telnet or ftp commands; or they may enter through a World Wide Web client.

The number of users of FedWorld today is large in comparison to more typical government online services that support only one or two key missions. FedWorld has over 100,000 registered users. The system supports more than 125 simultaneous dial-up and telnet users, giving an estimated capacity of 6,000 to 8,000 connections -- different users -- per day. At the same time, the ftp and Web services can support a comparable number of daily users. FedWorld's capacity was recently tested when the Washington Post ran a series of articles on FedWorld in the Federal Page. Daily connects, which had averaged 2,500 people per day, jumped to nearly 5,000 when the articles appeared; an additional 8,000 file requests per day were made to the Web and ftp servers. Daily connects to the system now average about 3,500 and there are routinely over 100 people using the system at a time.

Access to FedWorld is free to the public, and NTIS intends to continue to provide free access to the system. However, it is NTIS' goal to operate FedWorld as a fully self-supporting component of NTIS. NTIS has been supporting FedWorld's operations during its startup, and today, these costs are beginning to be recovered through the sale of products to the public, and through costrecovery for services FedWorld provides to other agencies under the Economy Act.

However, if FedWorld is to continue to be responsive in supporting Federal agencies' program and NPR goals, it will face predictable challenges in the areas of access, capacity, reliability, and ease of use. FedWorld has functioned effectively at its present size, but it must now grow to "industrial strength" if it is to meet its real potential to make government information more accessible and useful to the public. NTIS plans to use $4 million of the $8 million in investment capital for the hardware, software, and related capital investments to grow FedWorld to a fully functional size.

Access. While FedWorld can handle an impressive number of users, growth in the FedWorld user base (12% *per month* for the last 12 months) and the mushrooming demand from agencies for support of their clearinghouse and dissemination needs will require nearly an order-of-magnitude increase in the number of users FedWorld can serve at any time. In particular, projects like providing electronic access to 500 IRS forms and related publications will require FedWorld to operate at a commercial level of access comparable to companies like America Online, which has 1 million registered users.

Capital investment of $575,000 will allow FedWorld to upgrade its existing communications server to a single central management system that will handle the whole variety of communications modes that users may wish to use. These will include Internet telnet, ftp and WWW; X.25 packet switching (required to connect to FTS2000 or commercial services like Compuserve); dial-up; or local area networks. An immediate investment of approximately $400,000 will handle the initial transition and provide a 50% increase in lines of access within three months of authorization. The remainder will be invested within the following six months, putting the platform in place to handle the estimated nine million customer contacts in FY96.

Capacity. Similar growth in the hardware, networking, and storage capacity of the system is required, to keep the increased usage from degrading system performance and response time. As more and more agencies use FedWorld as a clearinghouse to communicate time-sensitive and valuable information, reliability and redundancy will become key issues.

Capital investment in hardware of $925,000 will ensure that customers do not experience degradation in the quality of service as the number of simultaneous users and the number of files being moved increases. Hardware investments will include Unix and Pentium systems to supplement capabilities of those in place; work stations and peripherals for the staff; and significant upgrades to the network to ensure rapid response. Software investments of

$450,000 will be required for networking software and tools; applications software for the staff; and expanded licenses for software accessed by the public. In addition, a powerful new commercial database searching package is anticipated to make it as easy as possible for customers to locate exactly the documents and services of interest to them. Since the current FedWorld computer equipment is crowded into an area of 10 x 15 feet, an additional amount of $400,000 will be required to fit out additional space for both additional computers and staff.

Reliability. Downtime must be kept to a minimum, with spare equipment ready to be "hot-swapped" in case of an equipment or software failure. Backup procedures must continue to be rigorous and more frequent, and plans must be implemented that would allow FedWorld to quickly be established in another site in the case of an emergency.

Capital investment of $250,000 will be required to provide a secure, reliable environment. This will cover improvements in the operating environment needed to maintain a computer system at peak performance --e.g., air conditioning, raised floors, uninterruptable power supplies. In addition, to provide for emergencies, improvements are needed for emergency systems for fire and security. One million dollars will be used to prepare a backup site and backup equipment adequate to bring FedWorld up in another location under emergency conditions.

Ease of Use. Finally, as FedWorld offers information from more and more agencies and programs, user interfaces must be substantially improved so that customers do not become "lost" or have difficulty locating the information they need.

Capital investment of $400,000 will be required to develop a new, graphical user ("point and click") interfaces, and to acquire and make the best possible use of the rapidly developing off-the-shelf software being developed for the Internet community. Customers should be able to enter the government's clearinghouse for information and navigate easily and efficiently to the documents of interest, with no prior training.

The FedWorld system architecture emphasizes flexibility and scalability. Even in its short lifetime of less than two years, FedWorld has already gone through several configuration changes to respond to increased demand and make use of more cost-effective technologies. However, the FedWorld network is designed very flexibly: when new technology becomes available to do a job more quickly and cost-effectively, the older equipment that was doing that job is not replaced -- it is reallocated to a less demanding part of the network. As a result, even though the overall FedWorld equipment configuration may change on an average of every 4 - 6 months, new equipment expenditures are kept to a minimum and are focused on adding only the most cost-effective and reliable new hardware and software solutions.

Conclusion

NTIS requires $8 million in capital investment funds to adequately address the challenges described above during FY 95 and lay the groundwork for future growth. Depreciation against these expenditures will be paid from the revenues generated by NTIS, so that capital will be replenished in the NTIS Revolving Fund for re-investment in future years, without the need for additional appropriations.

Mrs. MORELLA. I want to thank you both very much for being here and responding to the questions. We appreciate it very much.

Dr. GOOD. Thank you.

Dr. PRABHAKAR. Thank you.

Mrs. MORELLA. We are now going to ask the second panel to come forward. This is a large panel. We have six people, and this is going to be on the ATP program.

Dr. Dwight Carlson, who is the President of Perceptron, Incorporated, Farmington Hills, Michigan; Dr. Arthur Caisse, President and CEO of Cubicon, Incorporated, Zephyr Cove, Nevada; Mr. David Gibson, President, X-Ray Optical Systems, Albany, New York; Ms. Laurie Conner, Vice President, Marketing and Sales, Crystallume, Santa Clara, California; Ms. Cynthia Beltz, Research Fellow from the American Enterprise Institute in Washington, D.C.; and Dr. Edward Hudgins, Director of Regulatory Studies at the Cato Institute here in Washington.

I want to welcome the second panel. We are really looking forward to hearing your testimony, because you have had experiences and concepts and ideas about the ATP program which is important to this subcommittee and to the Full Committee, too, to look at and consider for the decisions we will make.

I thought we might start off—I am going to ask you, because of the time constraints, if you would confine your testimony to five minutes, knowing also that your total testimony will be included in the record.

I might start off, then, with my right, your left, and start off with Mr. Carlson. We will go in order. Then, after everybody has finished speaking, we will address some questions to you.

STATEMENT OF MR. DWIGHT CARLSON, PRESIDENT, PERCEPTRON, INC., FARMINGTON HILLS, MICHIGAN

Mr. CARLSON. Madam Chairman, may I use the overhead?

Mrs. MORELLA. Oh, indeed. I was waiting for someone to use that overhead.

Mr. CARLSON. Madam Chairwoman, it is my pleasure, and members of the Subcommittee, it is my pleasure to provide a private-sector evaluation of this key program.

I am here today representing the Auto Body Consortium, which is made up of eight small companies in Michigan. We are in the third year of an ATP program.

Mrs. MORELLA. Can you hear all right?

The REPORTER. Not really.

Mrs. MORELLA. She is having a little difficulty hearing. Maybe we could get you to be closer to a microphone?

[Standing at overhead machine showing vu-graphs.]

[Vu-graph.]

Mr. CARLSON. The ATP program, as you know, started in 1990 to make long-term investments in technology for the good of the Nation.

[Vu-graph.]

When we think in terms of competitiveness, this ad comes to mind, which is an ad that Toyota ran in 1992, which shows a ball bearing running on the seams of an automobile body. Essentially what Toyota was saying is they can have better manufacturing processes to produce an automobile than other folks in the world.

Having been a supplier to Toyota in Japan since 1971, and in Europe, I can tell you they do have the best manufacturing processes to produce automobiles.

When you think in terms of competitiveness of the Nation and how it is impacted as far as the auto industry, you need only look at one out of seven jobs in America are auto-related.

Our trade deficit, that is increasing, is two-thirds auto related. And the auto industry has a big impact on the gross domestic product, not to mention it is the largest consumer of steel, glass, carpeting, and other materials.

[Vu-graph.]

In the private sector we recognize this especially because the United States is the only Nation that has its auto industry concentrated in one community.

During the 1980s we attempted in the private sector to put together a collaboration between the research universities, the innovative industrial technology companies, and the major corporations.

In ten years of diligent effort, we had little or no success in doing that. The ATP has been a tremendous catalyst in making that happen in our community.

Through this federal funding, we have been able to attract the collaboration of smaller companies. As an example, those eight that make up the auto body consortia recognize that through the NIST/ATP the scarcest dollars of America, which are research dollars for manufacturing, are available.

In Japan, 80 percent of the R&D is into manufacturing process improvement.

In the United States we switched that around and we put 80 percent of our R&D into product improvement.

Another thing that the ATP catalyzes, in the United States we have a unique cultural advantage in our research universities. However, in the past universities have had a tendency to work with the Federal Government, whether directly and with major corporations.

The way the rules of the ATP have been set up, the money can go to small and medium sized companies like the one shown here.

When we have federal grants, the universities of America are very interested in working with us.

[Vu-graph.]

[Laughter.]

Mr. Carlson. As a result, we were able to put together this model. It teams the university researchers with the innovative industrial technology companies and with two of our major auto companies in America.

[Vu-graph.]

We put in a proposal to NIST, to the Commerce Department, and we were successful in winning a three-year, $5 million award.

We matched that with $7 million of private sector funding for a $12 million program. We are funding 10 research projects focused on improving the manufacturing process of automobile bodies.

In this project, we fund 34 researchers at the universities in their advanced manufacturing groups for three years. So the federal money goes to the companies and, as subcontractors, goes to the universities. So we are attaching the innovative companies with the researchers.

[Vu-graph.]

Results to date have been tremendous. We have implemented the technology and the techniques from the 2 millimeter programs in several automobile manufacturing facilities around the country.

As you can see here, we met three objectives. We have reduced cost. We have improved quality. And we have improved time to market.

At this point in time I can tell you that in our latest implementations we are now competitive with Toyota.

[Vu-graph.]

Yes, I believe—I was very skeptical when we started this program three years ago that we could do this, but with the NIST/ATP catalyst, we have a winning formula.

We are providing research dollars to smaller companies, and we are enabling them to team up with the researchers in the universities. That is taking advantage of America's unique cultural advantage.

[Vu- graph.]

Where are we going from here?

With a lot of private-sector involvement we have worked very closely with NIST and developed the motor vehicle manufacturing technology focus program of $185 million. Now that is over five years. So at this point in time I think we have a success.

We have a winning formula.

We have good leadership at NIST. The NIST people have been very helpful in making us successful, by the way.

In my career I have watched America lose one industry after another, the machine tool industry, the robot industry. This is the first time in my 25-year career I feel I am on a U.S. team that knows how to win.

The NIST/ATP was the catalyst to make it happen.

[The prepared statement of Mr. Carlson follows.]

A PRIVATE SECTOR EVALUATION OF THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY'S ADVANCED TECHNOLOGY PROGRAM

Prepared by Dwight D. Carlson
Chairman, Auto Body Consortium
President & CEO, Perceptron, Inc.

For

House Technology Subcommittee
of
House Science Committee

On behalf of
The Auto Body Consortium

APX International
ASC
Classic Design
Detroit Center Tool
ISI
Modern Engineering
Perceptron
Progressive Tool

March 23, 1995

Introduction

The purpose of this document is to present a first-hand private sector evaluation of the effectiveness of the National Institute of Standards and Technology's Advanced Technology Program (NIST ATP). This evaluation has been prepared on behalf of the Auto Body Consortium (ABC), a not-for-profit consortium of eight innovative small business technology suppliers to the U.S. auto industry.

In 1992, ABC teamed with General Motors, Chrysler, The University of Michigan and Wayne State University under a NIST ATP grant to jointly develop advanced technology to solve a critical auto industry assembly problem. This program was called the ATP 2mm Program.

This evaluation provides a first-hand accounting of the successful results of the ATP 2mm Program which is in its third year. It then defines the keys to that success and the vital role that the NIST ATP played. Finally, it establishes the reasons why further auto industry ATP support is critical, and how the ATP's Motor Vehicle Manufacturing Technology (MVMT) program area can deliver it.

2mm Program ATP

In 1991, the Auto Body Consortium (ABC) teamed with General Motors, Chrysler, the University of Michigan, and Wayne State University to identify a critical auto body assembly technical problem and proposed a joint technology development proposal to solve it. The team submitted an ATP proposal to NIST called the 2mm Program, and in 1992 received a three-year, five million dollar grant. The private sector (ABC, General Motors, and Chrysler) committed an additional seven million dollars to the program. The program runs from September 1992 through September 1995.

The 2mm Program ATP consists of ten research projects aimed at reducing auto body assembly dimensional variation to less than 2mm, plus a technology transfer research project.

The 2mm Team

The 2mm Program is organized as follows:

- Research is performed by the research university personnel from The University of Michigan and Wayne State University. The University of Michigan brings the expertise in mechanical and precision engineering required to attack and solve the 2mm problem. Wayne State brings unique technology transfer expertise to the team. The three-year research program provides sufficient time and funding for worthwhile Ph.D.-level research to be conducted. The coupling of the university researchers with the auto suppliers and auto manufacturers also provides a rich environment for defining future research agendas. U.S. research universities are a unique resource and competitive advantage for U.S. competitiveness.

- Innovation is performed by the small business technology supplier companies that form ABC. This is where the U.S. auto industry designs and produces its manufacturing processes, and where a process solution to the 2mm problem must come from. The companies receive the ideas and inventions from research and innovate products and services. Teaming and coordination between these companies is also essential to effect any significant process changes required to meet our 2mm goal. These smaller-type companies are also a unique competitive advantage for the U.S. auto industry.

- Implementation is performed by the major manufacturers, which face fierce global competition. In fact, several Japanese manufacturers have already attained less than 2mm variation in their auto body assembly processes. Since knowledgeable leadership and empowered teams are the key to success in implementing robust technology in the auto manufacturing environment, teaming with the ABC companies and universities to understand how to use the new technology is essential.

The successful teaming of these three elements is necessary to solve the 2mm problem. The major manufacturers need new products and services from the ABC companies, the ABC companies need access to the university researchers, and they all need each other because of the significant process changes required to solve the problem.

Objectives of 2mm Program ATP

The objectives of the 2mm Program are as follows:

- Reach world class levels of auto body assembly variation.
- Reach these levels in world class launch times.
- Maintain world class levels of process performance for the production life of the vehicle.

In other words, build auto bodies better than the foreign competition. Success hinges on the ability to do three things very well. First, to develop knowledgeable leadership within the team that will lead to the successful implementation of the 2mm Program in an auto assembly plant. Second, to empower the plant's entire body shop organization to successfully implement the 2mm Program. Third, to develop robust technology to provide enhanced tools and techniques to reduce auto body variation.

Achievements of the 2mm Program ATP

Beginning at the Chrysler Jefferson assembly plant which produces the Jeep Cherokee, the 2mm Program has been implemented in several auto/truck assembly plants. The first objective of the program to reduce variation to 2mm was achieved at Chrysler Jefferson in 44 weeks. With improved tools and techniques, the 2mm objective was recently achieved in 15 weeks at the GM Shreveport (Louisiana) assembly plant. The objective of maintaining world-class levels of variation on a continuous basis has been exceeded at the GM Linden (New Jersey) plant where variation levels are now running at 1.74mm.

An analysis of the payback for implementing the 2mm Program in a plant was conducted by Eastern Michigan University's Business School. Payback proved to be less than one year.

Once the concept of variation reduction is grasped in a plant and the 2mm Program tools and techniques are understood by an empowered workforce, variation reduction initiatives are spreading to other areas of the vehicle assembly process.

Plants implementing the 2mm Program are significantly improving their customer satisfaction scores as well.

The results to date of the 2mm Program ATP program's approach to variation reduction in auto/truck body manufacturing is exceeding expectations.

Keys To Success of the 2mm Program ATP

It is important to identify the keys to success of the 2mm Program. Using it as a model, the domestic auto industry can harness the unique cultural strengths of U.S. research, small businesses, and our major manufacturers to regain leadership in global competition.

- Teaming for International Competitiveness

  Prior to the NIST ATP program, there was no authorization which provided the necessary teaming structure and monetary support for auto companies, smaller suppliers, universities, and government to establish teams to improve the competitiveness of the domestic auto industry. At the onset of the 2mm Program, there was a great deal of skepticism and discomfort about this new teaming concept. Today, after three years of working together to prepare the proposal and execute the program, the teaming momentum is building and the initial skepticism has subsided. People are starting to believe that a partnership between industry and universities in America, enabled by government, can work.

  Without the comfort provided by the federal government through NIST that it is "o.k." to form teams to address industrial competitiveness issues, a "2mm Program" would not be possible.

  In today's fierce international auto industry competition, this form of teaming is necessary and is being done in other nations.

- Research Funding for Small and Medium Size Companies

  The National Science Foundation conducted research that concluded companies with less than 200 people achieved 25 times the innovation per investment dollar as do major corporations with 10,000 or more people. In America, it is these smaller companies which design and produce the manufacturing processes to build domestic vehicles. In the past, automobile manufacturing was somewhat of a low-tech environment. It was possible then to design and build the needed manufacturing processes within the cycle time of a new model. Not so today -- today's auto manufacturing plant is a high-tech environment going to even higher tech. Three-dimensional machine vision systems guide robots for flexible assembly and manufacturing data is networked by computers and displayed on screens throughout the plant.

The major difference is research for manufacturing. You can no longer wait for a purchase order to begin the research on an auto manufacturing process in today's high-tech, global auto manufacturing environment.

The first question is where are the small and medium size companies in America going to obtain research dollars to provide the next generation of auto manufacturing processes.

The second question is how are the small and medium size companies going to attract the researchers to perform the research.

The time span from research to commercialization of a new industrial technology is too long to be a viable venture capital investment.

Similarly, researchers are not attracted to smaller companies due to the lack of research facilities and research funding.

Therefore, without an answer to this situation, America's unique strength of innovation from smaller companies cannot be harnessed to solve the trade deficit problems.

As a solution, NIST ATP funding provides research dollars to small and medium size companies which are responsible for the success of the projects, thereby solving the research funding problem. Second, the smaller companies subcontract to the research universities that have the research facilities and Ph.D.'s to perform the research.

The 2mm Program ATP is a model for harnessing America's unique innovation strength to solve our nation's number one trade deficit problem -- auto related products.

- Teaming for Technology Transfer

In the past, the government's trickle down funding approach for research has had limited impact on industrial competitiveness. The challenge of this approach is the difficulty to link the researchers, the innovators and the implementors.

The 2mm Program ATP has built-in links between the university researchers performing the leading edge Ph.D. research and the innovative industrial technology companies that make up the Auto Body Consortium. These companies receive the ideas and inventions from the researchers and develop innovative products and services.

The final link is the implementation in the large auto companies that receive the products and services and implement them into the auto manufacturing process.

With this built-in linkage, research findings are being processed through the chain on a continual basis.

- The Private Sector Is in Charge

  While the ATP Program enables the essential teaming described above, it was the auto industry that was and is in charge of the 2mm project. The industry defined the problem, proposed the technology development required to solve the problem, and constructed the team.

  And it is the auto industry team that is responsible for directing the technology development during the 2mm ATP timeframe and, of course, will be responsible for any commercialization efforts after the ATP concludes.

  The ATP's role was simply to ensure the industry critical nature of the 2mm problem, assess the promise of the technologies described in the proposed technology solution, validate the commitment of the proposed team members, and ensure the necessity of ATP funds and its teaming environment.

  The ATP then got out of the way and let the U.S. auto industry help itself.

Why More ATP Support for the Auto Industry ??

The automotive industry is critically important to the economic health of the nation. Just ten years ago, conventional wisdom was predicting the U.S. would lose its auto industry to low labor cost competitors, and with it, the high paying jobs it supports. Fortunately, industry leaders with some government support have performed a near miracle in beginning to turn this prediction around by significantly improving productivity, maintaining labor costs, improving quality and stopping the slide in market share.

However, the battle is not over. It rages on with new competitors such as the Koreans who are committed to double their substantial auto production of two million units to four million units by the year 2000.

Global auto and truck competition is a fierce team sport with new competitors like Korea entering all the time. There is too much to lose, and the foreign competition too tough -- we must view the competitiveness of the domestic auto industry as a strategic priority for the nation.

The NIST ATP program through the 2mm Program has proven to be critical to teaming research universities, smaller automotive suppliers and the Big Three to accomplish what no one sector could have done alone. Through this program, we now have a powerful industrial competitiveness formula. We need to apply it to the next set of significant auto industry problems.

The next few sections expand on these points.

The Domestic Auto Industry's Impact On The U.S. Economy

The domestic auto industry has a significant impact on the U.S. economy:

- One in every seven jobs in the U.S. are auto related.
- The auto industry makes up 4% of the U.S. Gross Domestic Product.
- Autos and auto parts make up two-thirds of the U.S. trade deficit.
- U.S. trade deficit in motor vehicles went from $39 billion in 1991 to $44 billion in 1993.

And, the auto industry's impact on the U.S. economy is growing.

The Current Global Competitive Status of the U.S. Auto Industry

The global competition in the auto/truck market is fierce and will become even more so as global capacity exceeds global demand by 2000. New competitors like Korea are entering the market all the time.

- Recent J.D. Powers data indicates that Japanese automobiles captured eight of the top ten places in initial quality rankings.
- Model changeover losses on the 1995 Chevrolet Lumina were $191-244 million. Model changeover losses for 1994 Honda Accord were $7-8 million.
- The three most productive North American vehicle plants are Japanese owned.

The continued strengthening of the yen against the dollar has provided significant competitive relief; however, this cannot be relied on for the long term. Also, the 25 percent import tariff on trucks has also provided protection in a lucrative segment of the U.S. market. This, too, cannot be thought of as a long-term solution.

The only long-term strategy that will work is to continually improve the competitiveness of every aspect of the business to further delight customers.

Manufacturing Process Technology and Its Impact On Global Auto Industry Competitiveness

A significant difference exists in the allocation of strategic research and development investments made by the Japanese industry and U.S. industry. The Japanese invest 80 percent of their research and development into manufacturing process related research and development and 20 percent into product related research and development. The U.S. industry completely reverses its strategic research investments -- 20 percent process and 80 percent product.

As a result, a competitive gap exists in manufacturing tools, techniques, knowledge and workforce empowerment skills.

From a strategic perspective, it is easier to copy a new Ford Taurus product design than it is to copy and implement the now famous Toyota Production System. This system enabled Toyota to come to Kentucky and in a short time establish an auto assembly plant that produces at world class manufacturing performance levels as good, if not better, than Toyota plants in Japan. Toyota is the world class auto industry benchmark because of the Toyota Production System.

Fortunately, over the past five to ten years, this competitive gap has been recognized. However, the approach to rectify this situation has not been developed and remains a puzzle due to the inherent structure of the domestic industry as it relates to manufacturing process.

Who Designs and Builds Auto Manufacturing Processes in America

Unlike the Japanese auto industry which designs and produces its manufacturing processes internally, the domestic auto manufacturers rely on hundreds of small and medium sized companies.

In the past, these innovative companies could rapidly respond providing low tech solutions after receiving a purchase order and deliver within the time frame of the new model schedule. Today, the auto manufacturing environment has transformed from a low tech environment to one where high tech three-dimensional machine vision systems guide robots to flexibly assemble the vehicle and manufacturing process performance data is collected in seconds and networked around to plant-wide display screens.

These high-tech manufacturing process technologies of today require years of research and development. This creates a significant challenge for small and medium size companies expected to provide these state-of-the-art manufacturing processes.

The Need For Research and Development Funding

Research funding for manufacturing process research and development is extremely scarce in the United States. The venture capital industry which supplies a great deal of research and development money for high tech products has determined that the time frame from research to commercialization of manufacturing process technology is too long to be a viable venture capital investment candidate.

The Motor Vehicle Manufacturing Technology (MVMT) Program Area

In December 1994, after months of auto industry led discussion with the NIST ATP program, NIST announced the Motor Vehicle Manufacturing Technology (MVMT) program area. It is a five-year, $185 million program to foster innovations in manufacturing technologies that can strengthen our current manufacturing capabilities and lead to dramatic advances along the entire automotive production chain.

This program area will enable the U.S. auto industry to attack and solve the significant technological advances and process changes required for the U.S. auto industry to erase the gap in the J.D. Powers Survey results.

It will foster innovations that could slash time-to-market to 24 months, markedly better than even the best times logged to date by foreign or domestic car makers. Advances will lead to more versatile equipment, better control and integration of processes, and greater operational flexibility at all levels, from suppliers of parts, dies, and machine tools to assembly plants.

This is exactly the kind of government support the U.S. auto industry needs to remain competitive.

NIST ATP Evaluation Summary and Recommendations

Our NIST ATP experience over the past four years has been one of unqualified success. The program enabled the U.S. auto industry with its small business technology suppliers to address and solve a critical industry technology problem we would NOT have solved without ATP support. The 2mm ATP Program has enabled the U.S. to reach world class levels of auto body assembly variation and launch times, leading to higher U.S. auto quality, lower U.S. auto costs, and increased U.S. auto customer satisfaction.

From our perspective, the ATP Program is doing exactly what it should -- it is helping the U.S. auto industry help itself. It was the auto industry that identified the 2mm problem and the technological solution. But it was the teaming of the Big 3, its small business technology suppliers, and key university researchers that was necessary to solve it and was possible only through the ATP teaming structure and support. The ATP carefully ensured the industry critical nature of the 2mm problem, the promise of the technology solution, the commitment of the industry to solve it, and why the ATP was necessary at all before offering support. It then got out of our way.

But the U.S. auto industry and ATP partnership has just begun. In December, after months of auto industry led discussion, NIST announced the Motor Vehicle Manufacturing Technology (MVMT) ATP program area to further help the U.S. auto industry, and other manufacturing industries, solve their most critical technology problems. We believe this program area will be, and needs to be, equally successful in helping the U.S. auto industry help itself against increasingly fierce foreign auto industry competition.

Based on the U.S. auto industry's success with the ATP, the industry-empowering and effective manner in which the ATP provides support, and the critical need for continued support, our private sector evaluation strongly recommends continued support for the NIST ATP Program, particularly the Motor Vehicle Manufacturing Technology program area.

Mrs. MORELLA. Thank you very much, Mr. Carlson.

I would now like to present Mr. Arthur Caisse of Cubicon.

STATEMENT OF MR. ARTHUR J. CAISSE, PRESIDENT AND CEO, CUBICON, INC., ZEPHYR COVE, NEVADA

Mr. CAISSE. Thank you, Madam Chairman.

Mrs. MORELLA. Did I pronounce it correctly?

Mr. CAISSE. "Case".

I appreciate the opportunity to speak here today. I am president and CEO of Cubicon which represents the from scratch start-up. The NIST ATP funds helped us get us other funding to get off the ground. So we are the real "little guy."

Hardly an aspect of life today is not touched by computers, from toasters or ovens to space shuttles. Cubicon's mission is to increase the way software is developed tenfold. The results could affect the economy equivalent to the invention of the computer itself.

Basically I am a technologist turned businessman. This has allowed me to participate in all aspects of new high-tech ventures. In the process I have raised funds from venture capitalists, billion dollar corporations, individuals, and now the ATP.

My intent today is to attempt to introduce you to both the plight and the plague of an American institution, the high-risk start-up, and to point out the value of the U.S. economy of these start-ups, and to mention the critical role the ATP plays.

The first point is that revolutionary products that will really make a difference to the economy are, by their very nature, high risk.

The goal of the ATP has been made very clear. It funds high-risk projects that will stimulate the economic growth in job creation in the development of new industries.

ATP targets high-risk projects for only one reason. They are the ones that have the potential to create significant growth in the economy.

Those projects require cognitive leaps, paradigm shifts that make a real difference. This is not incremental research that extends today's products year by year. It is not business as usual.

I want to bring to the floor a phenomenon that may not be obvious unless you have lived through it. That is, that the start-up is a very highly leveraged American resource that has played significant roles in bolstering America's economy throughout the years, whether it is Wilbur/Orville or Bill Gates and Paul Allen, there is no doubt America has benefitted from the little guys.

They do have an impact on the GNP and the balance of trade. They have become a trademark of America's commitment to innovation. Why this is true, however, warrants some exploration.

There is a raw energy of a start-up that is hard to imagine if you have not experienced it. It is a powerful resource that can and is being tapped by the ATP.

America has groomed the best talent pool in the history of the world, and it is start-ups that brought out the best in the best. It motivates people to perform above reasonable expectations by offering them a reward: wealth.

The university researcher may get recognition, the corporate researcher may get a patent. But the entrepreneur may get rich. This is as American as apple pie.

There are certainly other reasons people do these things, but the subliminal message I believe in the "land of opportunity"—America's nom de plume—is that there is an economic reward.

The point is to point out that monumental rewards are required to motivate monumental tasks and monumental efforts toward those tasks.

When it does, the energy released is very incredible. It is the synergy of that talent and energy that can re-stimulate the economy and stave off the global competition.

It sounds perfect. America just directs this highly motivated talent to the high-risk, high-return tasks. But, alas, of course there is a problem.

Contrary to belief, venture capitalists do not invest in high-risk ventures. Their character is to minimize risk to increase the probability of profits. Their backers demand it.

It is too risky to tackle long-range technological breakthroughs even though the returns could be very large. Hence, what the venture capitalists invest in are ventures that produce product in 18 to 24 months and return five times their investment in a window of five to seven years.

So where does the high/risk, high/potential startup go for funds? Ironically, the very entities that set the goals so high they could benefit the whole economy are left to their own personal funds. Or, those of friends and family to work out of kitchens and garages until, that is, the ATP.

ATP targets just these ventures. In fact, by design if a startup did qualify for classical venture funding, the ATP funds would not be made available on that basis alone.

An ATP does not offer them just a dole; it requires recipients to demonstrate how they will become self-sufficient. It requires them to show the return is significant enough to warrant the risk.

By design, the ATP is not recurrent welfare. It is a proactive strategy that will create jobs in a large way.

The next point is, if we do not do it, somebody else will. The question is not whether or not tomorrow's solutions will be found; it is who will do it? If we don't, other countries will.

We have seen the effects of believing America couldn't be surpassed in industry. Other countries like Japan support their own industries through programs like MITI. They also pursue America's talent when classical funding is not available.

The criticism of the ATP has been that it has been picking winners and losers—that is, committing corporate welfare. Not in this case. By funding startups that would not otherwise be in the game, the ATP is not choosing among existing contestants; they are creating new players on America's team.

Margaret Mead, the acclaimed cultural anthropologist, reflected: "never doubt that a small group of thoughtful, committed citizens can change the world." Indeed, it is the only thing that ever has.

What would happen in America actually sought out these pioneers, identified, attracted, and nourished them? What would be the effect on America's bottom line?

Where is the next American company that will put us yet again in the front of market leadership? And what will happen if we don't?

The continued ATP funding will help to answer those questions. I have attempted to bring to light the extraordinary and unique role that ATP fills.

Thank you for your time.

[The prepared statement of Mr. Caisse follows.]

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TESTIMONY
by
Arthur J. Caisse
President & CEO
Cubicon, Incorporated
for the
U.S. House of Representatives
COMMITTEE ON SCIENCE
on
National Institute of Science and Technology's
Advanced Technology Program

24 March, 1995

Introduction and Purpose:
I appreciate the opportunity to speak today. My name is Arthur Caisse, I am currently the President and CEO of Cubicon, a recent recipient of $2,000,000 of ATP funds.

We are a four person start-up with technology aimed at increasing the efficiency of software development ten-fold using a new visual paradigm employing color, shapes, patterns and animation. The result will be software composed of highly reusable components; much as hardware is produced mainly by combining existing chips. This enabling technology will be used to produce an international electronic marketplace for not only developing and protecting these components, but for marketing them globally. The impact could be on the same order as the invention of the microprocessor itself.

Cubicon is characteristic of a particular breed of entrepreneur: the high-risk, high-return start-up. I am here to define it and its significance to the U.S. economy, and specifically to bring to light ATP's impact on leveraging this valuable American resource

My background is that of a technologist turned businessman. My area of familiarity is computers, communications and information services. I have participated in the identification, invention and creation of communications and information products and services since the mid-60s.

Since 1987, I have been working with entrepreneurs in bringing their visions to reality. This includes contributions to the technology itself, product and market definition, business strategy, team building, and funding strategies. In the process, I have obtained funding from venture capitalists, corporations, individuals, and now the ATP.

My intent here today is to share with you from that background what might not be obvious: the plight and value of the entrepreneur with very ambitious goals. And to bring to light the potential that ATP funding alone addresses. And of its value to America..

The Goal of the ATP funding is:

> "... high-risk research and development projects leading to practical technology that will ...stimulate *economic growth* and *job creation* through the development of *new industries*."

The question then is: "how should government best spend or not spend, to achieve them?" Who should get government funding? And why?

Corporations vs. Start-ups:
The two main contenders are corporations and start-ups. Corporations certainly create new products and technologies in order to grow revenues and of course this creates jobs as well. And they fund research to do this. However, their priority is typically next year's bottom line; especially if the company is public. In recent years some of the most notable contributors to research such as AT&T, IBM and Bell Labs and others, have been forced to lower their research investment level and shorten their investment horizons due to the recession, loss of market dominance and increased competition,.

The point is that when profits are threatened, research funding suffers. Matching ATP funds can and do encourage corporate investment in high-risk, high-potential research during 'tight' times . This leverages corporate assets in America's interests. However, that's not my expertise; and others will address that issue.

What I do know is that at least established corporations have the option and resources with which to pursue breakthrough research if they choose. This is not true for the start-up.

The 'Classical' Start-up:
Classical start-ups share certain characteristics. These can be characterized as a small group of technological talent combined with real-world experience, credibility and a vision of a technological breakthrough that meets a specific market need.

In order to obtain funding from the venture capitalist community they must meet two other very specific criteria. They must produce a product in 18 to 24 months, and provide a return on investment to the venture capitalist of about five times in five to seven years. And of course the venture capitalists opt for those opportunities with minimal risk. Therefore, these start-ups typically only push the envelope of the existing technical paradigm. They deal in 'incremental' progress. It's safer.

And it works. Start-ups have produced a large and critical portion of market newsmakers today. They have in fact, become a symbol of American innovation and leadership. Their successes affect the GNP and balance of trade.

Then what could be wrong with this picture? Nothing, as long as you are an entrepreneur with an opportunity that will produce a product in 18 months. But this 'filter' usually means that opportunities that are apt to produce breakthroughs or paradigm shifts, the kind that might create totally new industries, are passed over.

The 'High-Risk, High-Payoff, Enabling Technology' Start-up:
It is important to distinguish between this classic form of venture capital backed start-ups and those that pursue long-term technological breakthroughs, new businesses and markets. These focus on technological innovation that causes actual paradigms shifts in their target markets. These more formidable opportunities require cognitive leaps in the way we approach a solution, are by definition, higher risk. They have product horizons of five or more years. When they hit, they positively affect the GNP. It's high-risk; high reward.

The unfortunate truth is that the venture community does not fund this type of start-up. The ones that could produce paradigm shifts, achieve technological breakthroughs and create new businesses. The very kind that the ATP program aspires to promote because it will grow the GNP.

Then how about funding from corporations? Corporations are not in the business of the venture capitalists, nor do they share the goals of the ATP. Corporate directors are bound by their fiduciary mandates to promote their company's prime interests and strategies always leading to shareholder profit. Therein lies the risk. The classical warning to entrepreneurs is that they are a "flea on an elephant's back". This refers to the fact that if the company changes goals, budgets or any of a hundred other things, the relationship, and hence the enterprise, can come to a sudden end. I speak from first hand experience in a previous venture, where the changing of presidents in a multi-billion dollar partner brought my two year, ten million dollar venture to a sudden halt. When I pointed out that they were walking away not only from their ten million dollars, but the very results they started out to achieve, I was warmly told: "you have a lot to learn about corporate politics." And I learned.

And so that leaves the far-reaching entrepreneur with few places if any, to go for funding; adding to his already formidable task. The return is just too far out for the venture capitalist, and corporations are structured by design and default, to serve their own interests. There has been almost no source of funding that these pioneers could obtain; until the ATP came along.

Without the ATP America misses an opportunity to leverage one of its most valuable resources, the highly motivated pioneering spirit of the entrepreneur. America needs these endeavors to take root and thrive today; just as it has since 1776..

What Does It Take?:
Successful investment in high tech takes more than just money. There are several elements that are required to produce a market leader.

People: Of course it requires vision and expertise, but it often also takes an evangelist; a champion. Someone who not only sees the vision, but acts on it. The world is full of great ideas; but few act on them. It takes tremendous effort, courage, vision, execution, timing and luck; as well as financial resources. Would there have been an Apple without Steve Jobs? A Microsoft without Bill Gates? Or Cypress Semiconductor without T.J. Rogers?

Motivation: What inspires and motivates these individuals? Lots of things, but the paramount one is money; and the exceptions only prove the rule. Financial incentive is as American as apple pie. The university researcher may get his recognition in academia. The corporate inventor may get his/her name on a patent. But the entrepreneur gets rich. The point is that to put forth all that is required to create a market leader, requires a commensurate reward. In America, that's wealth.

Abraham Maslow pointed out that the highest motivation in humans is survival. And in today's world, that manifests as money. America's formula for incenting individuals to ensure their survival by raising their standard of living is unsurpassed in history. America's trademark is "the land of opportunity". Ask any entrepreneur if financial gain wasn't a significant motivation, not only for themselves, but for the other key employees of the founding team.

The ATP strategy wisely acknowledges and harnesses this very strong motivation in the country's best interests. It can move mountains. It can also take its toll.

Rewards: Silicon Valley is littered with burned out entrepreneurs, broken families, bankrupt savings accounts, and other debris of those who 'took the leap'; and missed. I can testify that even the successes take similar tolls. The unreasonable amount of risk, effort and sacrifice must be balanced with a commensurate reward for the individual. It is one reason government funding of non-profit entities doesn't tap this essential high-energy resource. These entities cannot promise the 'unreasonable' rewards required to inspire the individual to make the 'unreasonable' commitments. And yes there are admirable exceptions; but again, they only prove the rule.

This is not to imply that pure research is not indeed a very valuable process. But the end result is not to produce revenue generating products and industries. Conversely, the ATP specifically dictates that projects must have a goal of not only self-sufficiency; but of positively impacting the GNP. By design there is an end to government support. It therefore instigates and supports only 'win-win' endeavors. Those that motivate the receiver of the funds with commensurate rewards. And those that reward the taxpayer as well. One of the concerns heard from those that oppose prior Government funding of research is that it hasn't resulted in 'products'. ATP is a different approach.

Patience: Nor should it be expected that every ATP grant shall produce results. No more than it is expected that venture capitalists will hit on every investment. And because the goals of the ATP demand even more significant breakthroughs and accomplishments than the venture capitalist, the hit rate might even be lower. But in the case of the ATP, when a success is achieved, the returns are massive, and long lasting.

America's Opportunity:
America is striving hard to maintain its lead in several industries. Cubicon's industry, software is a good one to examine; one where the U.S. currently holds its own. However, software development methodologies have not fundamentally changed commensurate with the hardware advances. The result is an inability to produce the systems to meet the ever growing need. And since computerization is touching every area of industry, any advance in software production and maintenance would spread to all aspects of commerce. There is tremendous potential for leverage.

ATP funding of companies like Cubicon can give America the tools to solve its own problems and produce very significant returns for the economy. And the question isn't: "if it's going to be done". It's "who is going to do it"? And where?

America can't afford to overlook these small entrepreneurs because of their ambitious goals. Especially when it is exactly these same goals that will so serve America's growth and prosperity.. Who knows how many more Wilbur and Orvilles might emerge if there is a funding source that doesn't turn them away.

Cubicon for example, had been seeking funding no avail. Using private funding from friends and family, the Founder, Sanford Klausner, has been developing the core technology to 'reinvent programming' for over seven years. With the ATP funds made available, Cubicon will be able to perform the final research that will demonstrate the viability and value of its new technology. These results will attract other sources of funding required to complete commercialization..

Which brings to light another advantage inherent in the ATP approach. In the venture capital industry, there is a phenomenon whereby once a credible venture capitalist takes the position of 'lead' investor, the rest follow. The ATP fulfills the role of the lead investor for these high risk ventures. This 'priming of the pump' will bring other non-government investment. Entrepreneurs are not looking for a 'dole', only a 'jump-start'. They represent an opportunity for America to tap another resource; one that has been overlooked and underutilized in the past.

Summary:

America needs to invest in world market preeminence if that is what it wants. The current paradigm for commercial investment in America is not charted to pursue the larger goals of the ATP. It deals mainly in incremental extensions of technology.

The non-profit research centers don't have the charter or infrastructure to carry on past the research phase to commercialization .

Large corporations hopefully will use profits, tax breaks and their significant resources to pursue these goals, and should be encouraged to do so.

Short term, lower risk incremental entrepreneurs can turn to venture capitalists; and this continues to be good for the economy. There may in fact, be ways that ATP funds can be used to complement venture capitalist funds to extend their horizons to include riskier high-potential ventures. In doing so it could leverage the expertise and experience garnered by this industry to enhance the country's own ventures.

It is the far-reaching start-ups, targeting difficult but substantial results, populated by highly motivated entrepreneurs, that by definition produce new industries, markets and jobs. These high risk start-ups, the ones that because of the magnitude of their goal, can't get conventional venture funding, are the very ones likely to produce whole new industries or revolutionize existing ones.

These pioneers, striving to change the world, are left to do it on their own. We want them to overcome the technological challenges required for a breakthrough advance. We want them to take on the global market competitors to an extent that they affect the balance of trade. But there is no support system. They are left to pull off this amazing feat, this breakthrough in both business and technology, on their kitchen table or garage; on a shoestring. We demand they start from scratch. Until the ATP.

Margaret Mead, the acclaimed cultural anthropologist reflected: "Never doubt that a small group of thoughtful, committed citizens can change the world: indeed, it's the only thing that ever has."

What would happen if America actively sought out these pioneers; identified, attracted and nourished them? How many more Microsofts would be produced? What would be the effect on America's bottom line?

It is this extraordinary and unique role that the ATP fulfills that I have attempted to bring to light here today. Where is the next American company that will put us yet again in the position of world market leadership?

Continued ATP funding will help answer those questions.

Mrs. MORELLA. Thank you very much, Mr. Caisse.

And now, Mr. David Gibson, President, X-Ray Optical Systems, Albany, New York.

STATEMENT OF MR. DAVID GIBSON, PRESIDENT, X-RAY OPTICAL SYSTEMS, ALBANY, NEW YORK

Mr. GIBSON. Thank you, Madam Chairman.

I am presenting the viewpoint of a small company which has been active in the ATP program and is nearing the end of its ATP program.

I will do so by giving you the specific example that we have gone through, and then by making a few general comments.

Our company was started to develop a program to develop and commercialize a technology for focusing X-rays in neutrons. It is an important point. It has a broad range of applications in medical imaging, in medical therapy, in material analysis, or non-destructive testing across a wide range of industries including semiconductor, pharmaceutical, aerospace, biotechnology, and other scientific evaluations.

The status of the company at the time we applied for our ATP award was that there were a few existing optics which had been made in other countries, but they had poor performance. There was no U.S. design or manufacturing capability, and there was very little capability anywhere in the world.

Because of this, there was only very limited ability to even evaluate whether this technology might some day offer the benefit to those applications.

We, likewise, were extremely small. We had only two employees, only one of whom was being paid—and that, poorly.

We looked at all the available funding options. Perhaps it would be instructive—I can give you a little bit of our experience.

First we started with personal funds, and those of friends and family. Those funds were used, but are simply not sufficient to demonstrate a new technology.

We looked at venture capital, and we talked to a fair number of venture capitalists. It was clear that we were at too early a stage. They would be interested in talking to us later once we had working prototypes and demonstrated that we knew how to make it.

A public offering was certainly too early. Corporate funding, which we had high hopes for, did not play out. It became obvious that the larger companies had very short time horizons for investing in their suppliers' R&D, if they would do it at all.

And—and I think this is more important—because of the broad range of applications of our technology, any individual company we would talk to would only be able to utilize a fraction of the potential uses of that technology. So they just did not value the others at all.

There were externalities that the market was not capturing. That is also true for private investors and for initial public offerings. It is difficult for people to evaluate different aspects because they only know one area.

We looked at government funding, but it was not very appropriate, the other sources. We were past the basic research stage. There wasn't any questions of what the physical principles were, but we were not yet able to apply the technology to the different applications where there was a considerable amount of funding.

We went to private investors, but very few private investors were able to evaluate the technical issues. Bank loans are not available. The area of tax credits and other business incentives has been brought up. They are irrelevant for high-tech startups.

To get any benefit from those, you have to make income. We will not generate any taxable income until after the technology feasibility has been demonstrated. So they don't even figure into our decision matrix. They do not provide any cash.

Well, we applied for the ATP funding in 1990, the first competition, but were turned down—appropriately; we had not done our planning.

We went back, did more planning, and reapplied to the 1991 competition with funding starting in 1992. We were one of approximately the first 35 companies.

Realize, we were some of the first ones, and we are now almost finished. So it is a very new program.

We requested ATP funding for a technology feasibility test. We did not request any funding for the application-specific developments, for those applications I mentioned—for medical imaging, for lithography, or for any of the others.

We assumed that if we could demonstrate the feasibility of the base technology, that we could get product development funding from other sources.

Now we found—and we had not expected it—that the technology assistance from NIST was critical at a number of points as we went through.

When we hit a roadblock, we could go back to the labs and talk to the researchers who had good equipment, high skills, and they could help us over the roadblocks we hit so we could proceed.

I think the probability of us failing would have been very high if we had not been able to have those technical expertise interjected at the right points in the process. I guess I make the point that ATP funding is different from other government funding which we have received since because it comes along with that capability to give you a boost technically.

The technical capability of our optics have been successfully demonstrated. I have with me today one of the prototypes we have manufactured. We are now able to make it in the U.S. We have the design capability. We can evaluate if they work.

From that, we have gone into product-specific development not funded by ATP. We have begun that in medical imaging in both mammography and angiography. We are doing that in X-ray lithography, and in about four or five different material-analysis applications.

We have received private funding because of the success of this program, and corporate funding as well. I think there will be benefits to the U.S. economy on three levels.

First and most important to us personally is sale of the optics, because that is where we get our return. More important to the country is from the sale from the equipment manufacturers who will incorporate our optics in their equipment.

The largest potential benefit will be to those who get the benefit of that equipment in making higher quality materials and improved health.

It is pretty clear that without ATP funding our company would have remained a shell corporation simply managing intellectual property, and we would have waited the 10 or 15 years for the university-based research to move on.

From companies at our stage of development, ATP funding does not displace private funding. It acted as a multiplier to bring in corporate, other government sources, and private.

For example, on the personal funds side, once we had the ATP funding to take care of our part of the match, part of what we did was borrowed everything we could, spent all of our savings, I sold my house—you know, that is what it takes. I don't mind that, but once the other part was taken care of, we can do it. My wife, however, did mind that.

[Laughter.]

Mr. GIBSON. Our overall assessment of the project is that it can be very successful for the companies and for the American people for a couple of reasons, and I will step back from our particular experience.

One, it is a nonpolitical selection process.

Second, there is extensive technical review.

Third, it includes many small bets. It is not a hundred million dollar bet; it is a lot of small ones.

Do you need me to finish, Madam Chairman?

Mrs. MORELLA. One more sentence.

Mr. GIBSON. It involves working with companies that have incentive to succeed. We are going to succeed. There are no carrying costs for unsuccessful bets because if the technology does not work, the companies either close the project or fail.

Overall, my recommendation would be. Provide continued support because the program will not solve all funding R&D issues, but meets a particular set of needs.

As a taxpayer, both private and corporate, even though we will probably never receive an ATP award again in the future, I am willing to pay my taxes to fund this one because the program works.

[The prepared statement of Mr. Gibson follows.]

A STARTUP COMPANY EVALUATION OF THE ADVANCED TECHNOLOGY PROGRAM, NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

David M. Gibson
President
X-Ray Optical Systems, Inc.

for the
House Technology Sub-Committee
of
House Science Committee

23 March 1995

Purpose and Introduction

I will be presenting a small company participant's perspectives on the ATP program. Our ATP project resulted in the development of a new technology with important applications in several industries. Without the ATP, the technology would have taken more than a decade longer and the U.S. would not have had the lead.

I am David Gibson, President of X-Ray Optical Systems, Inc. My background includes technical, business, and leadership experience. Academically I have degrees in engineering, economics, and management from MIT. Professionally I have been an infantry officer, a sales and marketing manager for technical products, and a senior-management consultant specializing in corporate strategy and operations.

X-Ray Optical Systems, Inc. (XOS) is a small company started to develop and commercialize a particular new technology for controlling x rays and neutrons. The company strategy is to be experts in the x-ray and neutron optics across the wide range of potential applications. An important element of our approach has been establishing collaborations with individuals and organizations who are experts in the applications and in developing the equipment which will utilize the optics. These experts are located at universities, companies, and federal laboratories.

X-Ray Optical Systems, Inc. (XOS) Technology

Our technology is an entirely new method for controlling x-ray or neutron beams, the only technology for controlling a wide-angle broad-spectrum beam. Applications include:

- medical imaging, including mammography and angiography
- medical therapy using x rays or neutrons

- x-ray lithography for manufacturing high density computer chips
- material analysis/non-destructive testing for:
    - semiconductor
    - pharmaceutical
    - aerospace
    - biotechnology
    - other
- scientific evaluations such as satellite born x-ray concentrators for spectroscopy of distant radiation sources

Leading up to the Company's ATP Award

The technology was invented and a couple of poor prototype optics were manufactured in Russia. XOS managed to secure the international rights for the technology. Initial funding was from personal funds, friends and family, and a small R&D contract for one application. The few optics which existed had been sourced from Russia as there was no U.S. design or manufacturing capability. The general perceptions of the technology community were that the technology: did not violate any theoretical principles; hypothetically could deliver interesting benefits to a variety of applications; could not at that point be evaluated in terms of how much benefit it could theoretically offer to the applications; and practically would probably never be able to be manufactured in usable form.

Other Funding Opportunities

We looked at all of the available funding options:

- Personal funds and friends and family. These funds were used but were not enough.

- Venture capital. This was pursued but was found to not be a viable funding mechanism for several reasons. The technology was at too early a stage. The costs to demonstrate feasibility were less than the $3 million or so the venture capitalists typically want to invest to justify their due diligence and management costs. The VC's need for control of the company at even the earliest stages removed the incentives for the founders to start a company. For example, one VC told us that of course they would expect to control the company from the time the first dollar was invested, even if they did not have the majority ownership position.

- Public offering. It was too early as it was not possible for the market to evaluate the technology's potential.

- Corporate funding. We had expected this to be an advantageous funding source. After talking with a wide variety of companies it became clear that they had very short time horizons for R&D investments and generally did not desire to invest in their suppliers' R&D. In addition, the potential corporate investors are usually potential customers of the technology. But because of the broad range of applications of the technology, any individual company would only be able to utilize a fraction of the potential uses of other technology.

- Government funding. Other than ATP, government R&D funding is generally available for study of basic phenomena or is oriented towards very application specific projects. Although the basic physics was understood with our technology, there were numerous technical details which had to be resolved before we could do any serious application development.

- Private investors. This is the source of the majority of startup funding in the US. The funding level that we needed was higher than is typically available from private investors, and very few private investors were able to evaluate the technical issues.

- Bank loans. Not available.

- Tax credits and other business incentives. Although helpful for established companies, they are irrelevant for high-tech start-ups which will not generate taxable income until technology feasibility has been demonstrated.

It became clear to us that it is very difficult to fund a new technical venture if the technology is not yet at the product development stage and if the product has multiple applications across a variety of industries. In that case, corporate sponsors see only a fraction of the potential benefit and analysts typically do not have the experience to evaluate the range of markets.

We applied for ATP funding in 1990, the first competition, but were turned down. We reapplied to the 1991 competition, with funding started in 1992.

Application for ATP Funding

- Status at the time of application:
    - a few existing optics, poor performance
    - hypotheses of benefits for a wide range of applications
    - no U.S. design capability and little capability anywhere in the world
    - very limited ability to evaluate potential benefit for applications
    - no U.S. manufacturing capability
    - no knowledge of the lifetime of the optics in use
    - 2 employees

- We requested ATP funding for:
  - developing a design capability
  - determining if it was feasible to manufacture optics with sufficient performance
  - understanding the limitations of the useful lifetime of the optics
  - no applications specific development was included (this would be funded by other sources later if the above points were successful).

- Requested technical support. In addition to financial support, XOS requested, and received, extensive technical support from the NIST laboratories. By obtaining highly qualified technical support from the existing NIST labs at the critical points in our development process we were able to: greatly accelerate the project; reduce the technical risk; and reduce the cost of the project.

Results from XOS's ATP Project

The technical capability of our optics have been successfully demonstrated. We have developed design tools so that we can evaluate the potential of the optics for the different applications. Manufacturing has been demonstrated, but subsequent to the ATP project will need extensive ramp-up from the demonstration project to full production. Private funding has been obtained based upon the selection for ATP funding. Private investors relied on the ATP technical review and then completed their own market analysis. Additional funding was available based upon the technical results. We have started projects to apply the optics to a wide variety of uses including medical (including mammography, angiography, and boron neutron capture therapy for cancer treatment), x-ray lithography, and material analysis (including protein crystallography to support NASA's AIDS protein experiments). Strong collaborations have been formed with original equipment manufacturers. Capable US suppliers have been identified and qualified

There will be benefits to the US economy on three levels:

- sale of optics;
- from equipment manufacturers sale of complete medical and material analysis systems which incorporate this enabling technology into high-value competitively-superior products;
- benefits from using these systems such as higher quality materials and better health.

Probable Status of the Technology in the Absence of ATP Funding

In the absence of obtaining ATP funding XOS would probably have remained a shell company. The R&D would have been primarily university-based programs with an expected 10-15 years delay before optics were demonstrated in any commercially useful applications. The US certainly would not have the technology lead and it is extremely unlikely that the manufacturing would have been conducted in the US.

ATP Does Not Displace Other Funding

From our experience it is quite clear that for companies in the stage of development that we were in, the ATP encouraged rather than displaced other funding. For us significant funding to cover the development of the underlying technology was not available. However, with the ATP funding to cover the direct costs of the development, the risk was reduced to a level where it made sense to put in personal funds and private investment to cover the indirect costs such as working capital, facilities, and administration. For an early-stage, high-risk technology it gave us confidence to make the commitment and personal sacrifices which are important in making success of an entrepreneurial startup. In my case this included investing all our family savings, borrowing all the funds possible from commercial sources and from family and friends, and selling our home to assist in paying the indirect costs and other costs which were not covered such as intellectual property protection. The technical successes of the project brought forth the larger funding necessary for application development, manufacturing ramp-up, and marketing ramp-up. This funding includes corporate and private funding so far, potentially venture capital in the future.

Overall Assessment of the ATP Program

The ATP is very successful for the American people and the participant companies because:

- non-political selection process
- extensive technical review of proposals
- it includes many small bets, massive small-scale experimentation rather than trying to predict the twists and turns along the technological frontier by investing in megaprojects
- working with organizations which have a very large incentive to continue the research after ATP funding stops
- no carrying costs for unsuccessful bets (unlike investments in technologies in federal laboratories or somewhat in universities, if the technology is unsuccessful or is bypassed, the companies will either drop it or fail, avoiding building a bureaucracy with a continuing funding requirement for the government)

- oriented on those technologies which are at a point where they are less fundable by the market (eg. early stage and multiple applications)

- targeted at those technologies which could lead to private investment and high commercial impact if successful.

Recommendation

Provide continued support of the Advanced Technology Program.

Because of its focus on early-stage, high-risk, high-benefit technologies which are not easily funded by the market place; its approach of using a large number of small bets; and NIST's ability to provide technical as well as financial support; the program meets a unique set of important needs with significant benefit to the U.S. economy. If there are particular problems with some aspects of the program, then fix those.

This is a program which works.

Mrs. MORELLA. Thanks, Mr. Gibson.

I would now like to ask Ms. Laurie Conner if she would comment, vice president, marketing and sales, Crystallume, Santa Clara, California.

Thank you.

STATEMENT OF MS. LAURIE CONNER, VICE PRESIDENT MARKETING AND SALES, CRYSTALLUME, SANTA CLARA, CALIFORNIA

Ms. CONNER. Thank you, Madam Chairwoman.

It is a privilege to be here today to present my views and the views of our company on the role of the U.S. Government in fostering development of commercially important technologies, and specifically on the ATP program.

Government funding has been an important component to the success of our company since its inception over the last ten years.

Now Crystallume is a small, high-technology firm located in Silicon Valley, and I like to temporarily call the Valley, "the Valley of the floods," because of all the rain we have been having.

We are a leader in the international race to commercialize the new diamond technology for use in industries as diverse as automotive, aerospace, semiconductor, and flat-panel displays. The estimated market for this new technology is $4.5 billion by the year 2000.

Many large, multi-national companies are researching various aspects of this technology, including such companies as Fijutsu, Mitsubishi materials, Saint Gobain, a French company, General Electric here in the U.S., and others.

We feel qualified to present before the committee today because, since Crystallume's inception we have been awarded approximately 55 research and development contracts totalling just under $18 million, mostly through the very highly successful small business innovative research program.

Our SPAR funding has come predominantly from the Department of Defense, but we have also been under contract with the Department of Energy, and also the National Science Foundation.

We have also been awarded three contracts by the National Center for Manufacturing Sciences, NCMS, a DOD-supported industry consortium, and are currently under contract with the NIST/ATP program along with such important companies as General Motors, Ford Motor Company, Boeing, and Hughes Missile Systems, and Rogers Toolworks, which is in Arkansas, a popular state these days, to develop a new class of diamond-coated cutting tools to enhance productivity and lower manufacturing costs in these important industries.

We are not idealoges interesting in arguing the merits of government practices. We are an entrepreneurial venture that will succeed or fail on the new products we bring to our customers in the fastest way possible—customers like GM, Ford, Boeing, and others.

We are acutely interested in how to facilitate the technology development process to get our products to market faster, more cost effectively, and before our foreign competition. And in our industry there is a lot of foreign competition.

I also know that with all the international competition in the core manufacturing industries, our customers do not have the internal funding capability to help us develop key new technologies alone, especially when they are competing with other companies internationally such as in Japan which derives support from their respective governments.

First, government funding in the area of technology development is of vital important to small technology companies such as Crystallume. I can say that we would not have been able to survive the last 10 years on venture capital funding alone.

Our research contracts have enhanced our credibility with the venture community from both a technical and a financial perspective, not to mention the venture capitalists like to invest in companies that already have revenues—and of course R&D funds are a source of revenues.

Commercial technology development programs that look most like free-market systems seem to be the most useful in our view in engendering technologies, especially from small companies.

We don't have large lobbying groups that we can go to Washington to deal with the bureaucracy that exists. Many decision makers, many awards, fewer political motivations, more collaboration, and a straightforward framework is what works the best.

NIST's ATP program has the noble goal of "advancing technologies that have a significant potential for improving the competitive U.S. businesses," and I commend the program's efforts to support high-risk technology investment.

However, we have seen a number of areas where the ATP program falls short, and I would like to list those areas and provide some specific recommendations.

Number one, eliminate funding of foreign-owned corporations. I share the view that the U.S. needs to be world-competitive in technology development. However, I am familiar with at least one example where NIST funded a 100 percent foreign-owned corporation in the same general technology and industry that they awarded two previous contracts to U.S. owned based either base companies or consortia. Is this the best use of taxpayers' money?

Number two, reduce or eliminate funding of similar programs in the same technology area. Do we really need to use government research funding to foster multiple efforts in the same technology area?

ATP has funded programs not only in the same technology area but in the same application area. The program already encourages teaming of multiple suppliers and users on the same team. Certainly we believe that the technology usage would not support a program with her own limited resources if a monopoly was being created.

NIST should not be in the business of industry building. That is a decision to be made in the open market.

Number three, approach a more free-market system. ATP should be commended for its efforts to obtain industry comments in their stated focal-group area. Unfortunately, the ultimate decisions regarding which area to emphasize and which programs to fund are made within the NIST organization by government employees.

A better approach would be to include industry participants in the decision process itself, not just as advisers. That is, in concept, proposal selection, and project review.

Number four, reduce burdensome paperwork for proposal submission. While I applaud the ATP's efforts to do a good job of screening proposals, there is a lot of up-front work that needs to be done by companies, and especially small companies.

A better approach would be to require perhaps a one-page budget summary and a 20 page total proposal to be expanded after the award has been made so the effort is more easily justified.

Number five, reduce burdensome paperwork for awardee reporting. The reporting requirements of the ATP program are by far the most bureaucratic and cumbersome with which we have experience.

Our accounting and administrative departments spend two to three times the effort on ATP program administration than on other programs that we have had in the past. Our large partners have summarily refused to provide NIST with their overhead rates because these figures are considered confidential.

In summary, three points:

One, the government funding is critical to the success of start-up high-technology companies;

Number two, while the ATP program has an important goal to assist technology, it needs to be, think, act, and look as much like a free market system as possible.

And finally, we believe that other models of government sponsored development seem more effective in addressing the needs of companies such as government sponsored industry consortia and the SBIRP, Small Business Innovative Research Program.

Thank you very much.

[The prepared statement of Ms. Conner follows.]

STATEMENT OF
MS. LAURIE C. CONNER
VICE PRESIDENT
CRYSTALLUME, INC.
BEFORE THE
SUBCOMMITTEE ON TECHNOLOGY
OF THE
U.S. HOUSE OF REPRESENTATIVES

MARCH 23, 1995

Madame Chairwoman, it is a privilege to be here today to present my views on the role of the U.S. government in fostering development of commercially important technologies.

I understand the purpose of this hearing is to address issues of government involvement in technology development and, specifically, the usefulness of the NIST Advanced Technology Program (ATP).

Government funding has been an important component to the success of our company since its inception over 10 years ago. Crystallume is a small, high technology firm located in Silicon Valley. We are a leader in the international race to commercialize the new diamond coating technology for use in industries as diverse as automotive, aerospace, semiconductor, and flat panel displays. The estimated market for this new technology is $4.5 billion by the year 2000. Many large, multinational companies are researching various aspects of diamond coatings, including Fujitsu, Mitsubishi Materials, Saint Gobain (a French Company), General Electric, and others.

Since Crystallume's inception, we have been awarded approximately 55 research and development contracts totaling just under $18 million, mostly through the highly successful Small Business Innovative Research (SBIR) Program. Our SBIR funding has come predominantly from the Department of Defense, but we have also been under contract with the Department of Energy and the National Science Foundation. We have been awarded 3 contracts by the National Center for Manufacturing Sciences (NCMS) a DOD supported industry consortium, and are currently under contract with the NIST ATP Program, along with General Motors, Ford Motor, Boeing Commercial Airplane, Hughes Missile Systems, and Rogers Tools Works to develop a new class of diamond-coated cutting tools to enhance productivity and lower manufacturing costs in these critical industries.

We are not ideologues interested in arguing the merits of government practices. We are an entrepreneurial venture that will succeed or fail on the new products that we bring to customers like GM, Ford, Boeing and Caterpillar. We are acutely interested in how to facilitate the technology development process to get products to our customers faster and more cost-effectively, and before our foreign competition. I also know that, with all the international competition in the core manufacturing industries, our customers do not have the internal funding to help us develop key new technologies alone -- especially when they are competing with companies, in Japan for example, which derive support from their respective governments for commercial technology development.

Government funding in the area of technology development is of vital importance to small technology companies like Crystallume. I can say that we would not have been able to survive the last 10 years on venture capital funding alone. Our research contracts have enhanced our credibility with the venture community from both a technical and financial perspective. Not to mention that venture capitalists prefer to invest in start-up companies that have revenues!

Commercial technology development programs that look most like the "free market" system seem to be the most successful in engendering technology -- especially from small companies. Many decision makers -- most from industry directly, many awards, fewer political motivations, more collaboration among industry participants, and a straightforward framework to promote natural industry interactions are all important to the success of technology funding efforts.

NIST's ATP Program, has the noble goal of "advancing technologies that have a significant potential for improving the competitiveness of U.S. businesses" , and I commend the Program's efforts to support high risk technology development. As an ATP Program participant, however, we have seen a number of areas where the ATP Program falls short of achieving its stated goals. I would like to list these areas and discuss some recommendations for improving the current ATP Program:

- Eliminate funding of foreign-owned corporations - I share the view that the U.S. needs to be world competitive in technology development; however, I am familiar with at least one example where NIST funded a 100% foreign-owned corporation in the same general technology and industry that they awarded two previous contracts to U.S.-owned companies or consortia. Is this the best use of taxpayer's money?

- Reduce or eliminate funding of similar programs in the same technology area - Do we really need to use government research funding to foster multiple efforts in the same technology area? ATP has funded different programs not only in the same technology area, but also the same application area. The ATP Program already encourages teaming of multiple suppliers and users on the same team. Certainly we believe that the technology users would not support a program with their own limited resources if a monopoly was being created. NIST should not be in the business of "industry building"; that is a decision to be made in the open market.

- Approach a more 'free market' system - The ATP should be commended for its efforts to obtain industry comments in their stated focal group area. Unfortunately, the ultimate decisions regarding which areas to emphasize, and which programs to fund, are made within the NIST organization by government employees. A better approach would be to include industry participants in the decision process -- not just as advisors. Industry needs to be included at each stage: concept, proposal selection and project review. Ideally, the ATP would provide a framework, a structure which would promote the collaboration of U.S. companies in technology development -- and then 'get out of the way' and let the teams succeed.

- Reduce burdensome paperwork for proposal submission - While I applaud the ATP's efforts to do a good job of screening proposals on the basis of technical and business merit, the amount of up front work which is required to submit just the budget for an ATP proposal is very high. A better approach would be to require a one-page budget summary, and perhaps a 20-page total proposal, to be expanded after the award has been made and the effort is more easily justified.

- Reduce burdensome paperwork for awardee reporting - The financial reporting requirements for the ATP program are by far the most bureaucratic and cumbersome of any government program with which Crystallume has experience. Our accounting department spends 2-3 times the effort on the ATP as on any other program. Our large commercial partners have summarily refused to provide NIST with their overhead rates because these figures are considered confidential in the business world, and certainly confidential when you have competitors working on the same ATP team. In our case, NIST will not provide matching funds for overhead that is not reported, and the project suffers due to a structural issue. I might add that typically the small business suffers the most because the ATP funds are often disproportionately applied to the small high technology provider.

Summary Points

(1) Government funding is critical to the success of start-up high technology companies in the U.S.

(2) While the ATP Program has as an important goal to assist in advancing commercial technology in the U.S., the Program needs to be, think, act and look more like a "free market" system. We need to reduce the bureaucracy and at the same time maintain and encourage a framework for advanced technology development.

(3) Other models of government-sponsored development seem more effective in addressing the needs of companies and industries focused on commercial markets. SBIRs and government-sponsored industry consortia are the right approach to promoting technology development and collaboration among large and small, supplier and user companies in an industry. Future directions of the ATP Program should take account of other successful programs such as the NCMS and SBIR Program.

Additional thoughts:

We have seen a wide disparity among the government programs ......The closer the government program resembles a free market system, the more beneficial it will be to commercial technology development. Picture if you will a continuum of technology development programs, from a highly concentrated, monolithic structure such as ARPA, to a market driven, pluralistic, commercially oriented group such as NCMS.

In the case of the ARPA type of structure, you have a large amount of taxpayer's money being doled out by a relatively few ARPA program managers on their hand-picked topics. The process is highly politicized, and the winners are often those companies with the biggest lobbying efforts located in Arlington, VA. One case in point with which I am familiar is ARPA's Diamond Multi-chip Module Program. To develop this important application for microelectronics, ARPA selected the two largest companies in the business, one of which is foreign-owned. Three years and approximately $20 million later, the program is struggling to achieve some success. Two years before, a panel of microelectronics industry experts predicted that the technology would not be useful to them if ARPA followed its stated path. This type of structure is undoubtedly useful for developing military technology, but is a failure in terms of commercial usefulness.

On the other end of the spectrum are the Consortia such as the National Center for Manufacturing Sciences and Sematech. NCMS receives the preponderance of its funding as a line item in the Air Force's budget, but is very much driven by the needs of the 200 large and small manufacturing companies it has as members as well by the needs of the Defense Department. Technology program decisions are made by committees of member companies with interest in that area. Projects that are selected for funding must also be supported financially by the companies that participate. Reporting requirements are no more burdensome than what would be expected for any internally funded commercial program.

NCMS funding was in large part responsible for our first major commercial product success: diamond-coated cutting tools. We scooped the Japanese and the rest of the world, and our biggest customers were sitting right next to us on the team. Sound efficient? It is. NCMS provides an important vehicle for collaboration among industry competitors, big and small companies, customers and suppliers. Most importantly, it provides a framework, a structure to accomplish this collaboration. The collaboration is limited to North American companies only.

The SBIR Program is another successful technology development program. SBIR grants represent relatively small dollar amounts presided over by many decision makers. Basically any government scientist can submit topics for SBIR competitions. The process is apolitical, because few companies would spend much time lobbying for the potential to win a $75,000 contract. The SBIR Program fosters a huge amount of technology development in all fields from software to medicine.

Mrs. MORELLA. Thank you very much, Ms. Conner.

I would now like to turn to Ms. Cynthia Beltz, Research Fellow at the AEI, the American Enterprise Institute here in Washington.

STATEMENT OF MS. CYNTHIA BELTZ, RESEARCH FELLOW, AMERICAN ENTERPRISE INSTITUTE, WASHINGTON, D.C.

Ms. BELTZ. Thank you, Madam Chairwoman.

It is a great opportunity to share some ideas and thoughts on the Advanced Technology Program here today.

I see my role as one of the non-industry representatives here to pose a couple of questions and to share some comments.

By way of background, I, as you mentioned, am a Research Fellow at the American Enterprise Institute. I have also for the past couple of years looked at the economics of strategic industries and tried to look at that from an economic point of view.

Within that there is a case study—within that book there is a case study of HDTV.

A second thing I have done in the past couple of years is look at the venture capital market and this notion of the need for the government to get into the role, particularly in the seed capital level of financing. There is a book that I have done on that, as well, *Financing Entrepreneurs.*

Also included in my testimony, because I will not have time to go into specifics here, are two articles, one from Regulation from Cato on HDTV and the lessons to be learned with respect to industrial targeting—and there are a lot of similarities between things that have been mentioned here on this panel. Then also another article on the venture capital market. But I also find it necessary to call for clarification on a couple of things.

One is, it is absolutely essential for you all to clarify what you mean by "long term R&D." You have got the whole range of definitions going here on this panel, and earlier today as well.

You have heard calls for what is lumped under long-term R&D; we are not just investing for scientific knowledge, we are going to get more bang for the buck; we are going to set priorities that are going to be driven by industry; we are going to incentivize...

And then also based upon ATP's sort of three to five year outlook in terms of when you are having a prototype developed, one of which you just had demonstrated here today.

So again there is a very, very different definition of "long-term R&D" that is being used here than elsewhere as we have talked about the need to maintain government support for long-term R&D on the basis of things like NSF. I talk about that in my written testimony, as well. So those are some of the things.

The other thing that I would like to throw out is with respect to clarification. Again, no one is arguing that technology is not important for the economy. Of course it is.

The question is. What is the government's role in the promotion of that?

What is the government uniquely equipped to do?

Actually, the report that was mentioned earlier today by Michael Boskin was one that we sponsored at the American Enterprise Institute. That is looking at the role of technology in economic growth. There is a lot of new research being done on that.

It does not measure what is the role of technology sponsored by the government. So that is one point.

Well, we can get into a couple of other things. Let me just also say about the venture capital market that it is a cyclical market. We have seen a surging coming back.

Last year was almost a record year. It was a 50 percent increase over 1993. Early stage financing is one going strong, as well.

We can talk all about that, but what I am posing here are some of the general questions to look for the bigger picture. So let me just turn to a couple of points here.

One is that I think it is absolutely essential that you ask what is essential to be done here.

We are in an era of, whether for good or for bad, of tradeoffs and making hard choices. So you need to determine, is this program absolutely essential?

What is the problem that it is trying to resolve?

Is the government uniquely qualified to address this problem in terms of being better than the private sector?

It is on these grounds that I find it difficult to justify the Advanced Technology Program.

The Advanced Technology Program, as stated in its own literature, is to promote the competitiveness of U.S. business by accelerating the development and commercialization of technologies with substantial potential for enhancing U.S. economic growth.

Now to give credits to the reforms that have taken place over the last couple of years, this is not the old style industrial policy, the top-down stuff.

There are clear mechanisms built into consult industry, and someone actually argued to going to the other extreme where this whole thing is industry driven.

What I am going to talk about are some inherent limitations or inherent problems with the mission that is set out.

First of all, look at the competitiveness problem. What is the competitiveness problem? 1994, by any measure, was a banner year for American industry. American industry is strong. Profits are up. Productivity is up. Growth is strong at 4 percent. If anything, we are worrying about whether that is a sustainable rate and our financial markets are concerned about inflation.

As I mentioned before, the venture capital market is surging. The U.S. has returned as the largest exporter of goods and services, and American producers are on the leading edge of the computer revolution.

A whole series of reports came out last year also talking about competitiveness.

But there is an inherent problem with the targeting, the desire to accelerate the commercialization through the Advanced Technology Program.

This is a misguided decision, in my mind, to trust the power of government managers, no matter how much input they get from industry to do.

There are simple human limitations in terms of how well you can predict. No one is able to predict how accurately. Let me again just cite from ATP program material.

"It is suggested that their development of computer software will, for example, lead to a $230 billion gain for the economy and thousands of jobs. But who are we kidding? Not even the experts can predict that, or let alone how many jobs are going to be created.

These are questions that you need to look at as you look at these projections that your committee will be given.

The history of technological innovation is brimming with examples where the market potential was misjudged by one business, and then was developed in a totally different direction over a period of time.

HDTV is actually a very timely example of that. I will not go into that here. That is where I have spent some time studying. But on the front page of The Post today there is an article about how four short years ago HDTV was being heralded as the next most promising technology.

We had industry panel after industry panel here in Washington saying that this was something that we absolutely needed to do if we were going to benefit from this set of underlying technologies.

Well—and if we didn't do it fast, we were going to be in big trouble because Japan and Europe are way ahead in terms of what they were funding.

Well, Japan and Europe learned the hard way about the hazards of leaning on expert panels in their efforts to target industry. So my point there is simply that it is inherently difficult to target, in industry or out.

The second point is, it is an incentive problem. As I said, industry and government both had the targeting problem; but the problem wasn't government. You are not gambling with your funds. You are gambling with taxpayer funds.

So my question for the committee is—and it would be revealing to look at the answer. Would you be willing to invest your pension fund or your child's education fund on the ability, no matter how good you might think they be, the ATP managers are, to outperform the market. So that is another question.

Then, get to that point also. What is the government uniquely qualified to do?

We have heard about all the different business plans, et cetera, that are being put together by members of government in consultation with industry. That is duplicating a standard industry practice.

Why are we doing this? If it is something that we want to have more industry-led R&D, then I would suggest that you are going to get a bigger bang for the buck by reducing some of the tax and the legal reform measures that have been talked about earlier and actually elsewhere in the Congress today.

So those are some of the things that I would throw out as questions to look at. If you want more industry-led R&D, then why are we trying to funnel that through Washington? It seems to be better to let them do that direct.

And the last point that I would make is talking about getting the basics right. In this area of tradeoffs in time of sort of downsizing in government, it is absolutely positively important to set what are your priorities?

What is the role government has to play?

What is the economic role that you are charged with in the R&D area? It is to fund those areas that business is the least likely to fund. That is basic research with a traditional definition applied to it in terms of long term.

There is a disturbing trend underway that has been already remarked on today about the disturbing shift in corporate labs away from this longer term basic research.

That is the time for the government to be expanding, not cutting that area of science—or not be cutting science.

So I again would go back. What is the government uniquely qualified to accomplish?

It is not uniquely qualified to accomplish many of the things that you have heard today about ATP, no matter what they've tried to—the different measures that have been put into check and to work more closely with industry—but if you cannot, for whatever reason, if ATP passes this essential test in your mind, then I would recommend four minimum reforms—and this is where I would differ some strongly with some other members on the panel—is that we need to drop the requirement with respect to foreign-owned firms, the reciprocity requirement that they need to pass, meaning that before a foreign-owned firm can be considered eligible to participate, irrespective of how much they do in the United States, as the law now states that country, that firm will be held accountable for the practice of its home country's government.

So essentially using foreign investors in the United States as a crow bar to try to open practices up, to open markets abroad, or to change intellectual property rights, or whatever the latest trader investment concern of the day is.

That doesn't make any economic sense. Not either from a tactical point of view—and we could talk about that, in terms of negotiating strategy—or from an economic point of view.

The mission of the technology programs, if we are going to keep them, should not be burdened with trade and investment objectives, as well. It will only curtail their cost effectiveness.

If we are trying to create a world-class technology base, then why are we voluntarily curtailing our access to foreign technologies.

The other, quickly, things I would recommend is to shift away from focus areas. That has been a new shift in the past couple of years toward focused R&D areas.

Again, that is getting more into the target area. We can go back and forth in the semantics of this and the details of that, as well.

The other is this 50-50 cost sharing. The role of the government is going to be justified as a catalyst to get things going in the private sector in some area that is broadly understood to be understood for some long-term potential gain, then why 50-50?

That model comes from SEMATECH. Most folks agree that we could have done SEMATECH for less in terms of the government role.

So I would challenge the committee and others in Congress who decide to keep the ATP program to cut that down to 10 percent and let it be more reflective of the catalytical role that you are talking about for government.

And the last part of size. If this program is meant to be experimental to see how we are doing, to see how we can encourage this type of industrial R&D and what the returns are, then keep it at an experimental level and not have a 500 percent increase over two years. So those are my specific recommendations.

To wrap up, I would strongly encourage that you would look at the HDTV debate, because HDTV has many similarities to a lot of these technologies. There were multiple applications being talked about. There was a very strong lobby here in Washington to look at, well, look we can develop TV sets.

My question is. If we had had ATP in place at that point as it sits on the table now and the American Electronics industry had come in with their business plan, with all these companies signed up beyond it, some of the best companies as well as the small ones, would we have funded that?

Would we have gone down the wrong road, in retrospect as it turns out?

So those are the questions I would pose for the committee to address.

[The prepared statement of Ms. Beltz follows.]

STATEMENT OF CYNTHIA A. BELTZ

The American Enterprise Institute

THE ADVANCED TECHNOLOGY PROGRAM:

IS IT ESSENTIAL?

Before the
Technology Subcommittee of the House Science Committee

March 23, 1995

Madam Chairman, thank you for the opportunity to appear before your committee this afternoon to discuss the Advanced Technology Program. I was asked by your staff to provide brief background on my work and then comment on the need for an ATP program.

As you may know, I am a research fellow at the American Enterprise Institute where I have focused on high tech and international investment issues. Over the past four years, I have written a book on the economics of strategic industries which included a case study on the industrial policy lessons of high definition television (*High Tech Maneuvers*, 1992), contributed to and edited both a volume on venture capital (*Financing Entrepreneurs*, 1994) and more recently a volume on international investment (*The Foreign Investment Debate*, forthcoming.) I also write the "Paradigm Shifts" column for *Upside*, a magazine for high tech executives. I am currently working on a foreign investment project and writing *Technology and Jobs*, a study of the impact of technological progress on labor markets.

My written statement consists of three sections: some observations on the inherent problems of the ATP mission; a *Regulation* article that gives my views on the hazards of industrial targeting based on the European, Japanese, and American HDTV experiences; and, a *New York Times* article on the clash between the dynamics of entrepreneurial finance and federal ambitions with programs like ATP to increase the seed-capital role of the government.

First Principles. I find it helpful when evaluating a project to return to first principles: identify the economic problem, put it in context, determine if the government can address the problem better than the private sector, and conclude whether it is an essential responsibility of the government. On these grounds, it is difficult to justify the ATP.

The ATP Mission

1. To "promote the competitiveness of U.S. business by accelerating the development and commercialization of technologies with substantial potential for enhancing U.S. economic growth.
2. To "commercializing new scientific discoveries rapidly"
3. To "refine manufacturing practices"
4. "To make industry rich"
5. To generate "hundreds of thousands of jobs in the long term"

What "Competitiveness" Problem?

By almost any measure American business is healthy. In 1994 economic growth increased by 4 percent, corporate profits were up and the largest productivity gains in the past 20 years have sparked a new wave of investment in plant and equipment. The venture capital market is surging through a fund-raising renaissance, with new commitments increasing by 50 percent over 1993 to reach $3.8 billion in 1994. Early stage financing has been particularly strong. Indeed, our venture capital market continues to be the envy of our major trading partners.

The U.S. leads the world as the largest exporter of goods and service and has a trade surplus in advanced technology products; American producers are on the leading edge of a computer revolution that is gathering speed as consumer spending on information technologies and multimedia equipment accelerates. And finally, to confirm the obvious, a series of reports released last year from the U.S. Department of Commerce, the private Council on Competitiveness and the World Economic Forum in Switzerland details the growing competitive strength of American corporations.

What, therefore, is the competitiveness problem that the ATP program is trying to solve for American business? If government still wants to give industry a competitive boost, then it makes more sense to cut taxes and take action on the regulatory and legal reform measures being contemplated. Technology policy programs by comparison are small change.

The Targeting Problem

The Advanced Technology Program reflects a misguided decision to trust the power of government managers over the market as the vehicle to allocate R&D dollars and determine "potential economic impact" of new technologies. The shift toward "focus areas" of research further reflects this faith in government targeting over the marketplace dynamics. For each program area, ATP managers are faced with the task of assessing potential economic impact, the probability of subsequent commercialization; and the credibility of the program's proposed pathway to economic growth. ATP program material suggests that its development of computer software will, for example, lead to a

$230 billion gain and thousands of jobs.

But who are we kidding? No one -- not even the experts -- can know in advance which technologies will even have a 10 percent success rate let alone the number of jobs that will be created. Moreover, the U.S. leads the world in software and the venture capital market continues to pour money into new software ventures. Why is the government second-guessing the market?

Industrial targeting is notoriously difficult because the process is inherently disruptive and complex -- even more so today than in years past. The history of technological innovation is brimming with examples where market potential was misjudged by one business and then commercialize by a different firm, often in an apparently unrelated line of business.

HDTV is only the latest example of the experts being wrong. Japan and Europe both learned the hard way about the hazards of relying on a panel of experts to accelerate the commercialization of advanced, generic technologies in an emerging industry. They underestimated the dynamic complexity of the high tech food chain and overestimated their ability to play the role of consumers or producers.

Too much attention has been put on speeding commercialization and not enough attention given to the role of market forces in determining the timing and the "credible" paths forward to commercialization. Perhaps the most overlooked HDTV lesson for ATP and other technology programs was the role competition -- rather than collaboration orchestrated in Washington -- played in raising the productivity of American R&D expenditures, pushing innovation, and helping American firms to gain a competitive advantage in a some of the key underlying HDTV technologies. (See *Regulation* article)

Washington is also at risk of overselling high tech. The premise of the Advanced Technology Program and others is that high tech industries deserve special federal support because they provide spillover benefits for the economy that are not fully reflected in their profits. Underinvestment is therefore expected to be more of a problem than in other industries. But the evidence does not support such armchair confidence. For example, the social returns from investing in such mundane, low-tech items such as thread and stain remover significantly exceeded the private return.

Beyond the Advanced Technology Program, the fascination in Washington with high tech manufacturing is out of step with the fundamental productivity problem facing the country, namely, the service sector. If boosting economic growth is the objective, then service productivity should be the focus.

The Incentive Problem

The prediction problem of course is not unique to government. But there is the inherent problem that the government is not gambling with its own money. A revealing question for your committee and other members to ask is whether you would risk your pension fund or your child's education fund on the ability of Commerce Department staff to outperform the market. If not, why are we investing taxpayer dollars in that proposition?

Furthermore, if more industry-led R&D is the goal, then why not let industry keep more of its earnings to do it directly rather than channeling the money through

Washington? Think of the administrative cost saving. Each grant proposal now requires three technical experts as well as three business specialists. Instead of duplicating a standard business practice and getting into the business of strategic planning, these savings could be passed along in the form of a lower tax burden to let corporate investors do their own planning.

Getting the Basics Right

The industrial targeting debate and the ATP debate in particular is not about whether the government has a role in R&D. Clearly it does. But, this role needs to be focused on those areas that the private sector is the least likely to fund. This is basic research. It is the seed corn for future economic growth. Yet there is a disturbing shift away from long term research in corporate labs while in the government, under both the Bush and Clinton administrations, support for basic research has decreased as the National Science Foundation has been pushed in the direction of more applied research and tangible results. This is precisely the wrong direction for government R&D policy.

Sharing the Burden of Budget Cuts

Budget pressures and the new downsizing spirit of the congress force difficult choices and trade-offs. For each program, this committee and other members need to ask whether it is an essential use of taxpayer funds. If somehow the Advanced Technology Program passes this test, I would suggest a minimum of four reform measures:

1.) **Foreign Firms.** Drop the requirement that the home country government of a foreign-owned firm provide American firms reciprocal opportunities before it will be consider eligible to participate in ATP. It is economic nonsense to voluntarily restrict our use of foreign technologies when the stated aim of the program is to build a world class technology base. Imposing the burden of trade or investment policy objectives on technology policy programs will only further curtailed their cost-effectiveness.

2.) **Focus Areas.** Reverse the shift towards focus area research. The farther away the Commerce Department is from attempts at industrial targeting and accelerating the commercialization of specific technologies, the better.

3.) **50/50 Cost Sharing**. There is no economic reason why the government share should be 50 percent. This is an arbitrary number taken from Sematech, which many believe could have been done with considerably less government support. The economic case for cooperative R&D between firms is not a defacto case for government intervention, let alone a 50/50 financial relationship. Take a share of 10 percent as a more appropriate starting point for the government role in the project as a catalyst.

4.) **Size.** Cut program funding to a level more appropriate to the intended "experimental" nature of the program and reverse the 500 percent increase in funding over the past 2 years.

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Biographies

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Would You Invest in Bureaucracy Inc.?

By CYNTHIA A. BELTZ

CONGRESS is now mulling over a $1.9 billion proposal to make the country more competitive. The bill's supporters say that more government is just what this nation needs. But nothing could be further from the truth, and for a simple reason: Bureaucrats make bad business executives.

The proposal, the National Competitiveness Act, would create six new programs, two new offices in the Commerce Department and three new advisory boards. But its flaws are apparent from just one piece of the package: its $100 million venture-capital provision. Under this initiative, which aims "to stimulate and expand the flow of private capital," a new Federal licensing committee of five technology experts will select and support venture-capital firms that pledge to "accelerate the development of critical civilian technologies."

This idea is misguided. No panel of experts can outperform the ever-shifting, surprise-ridden marketplace. Nor should they try. The private sector is already focused on high tech, which received more than 75 percent of investments by venture-capital firms in 1993. The marketplace is virtually sizzling in electronics, software, telephone and data communications — all "critical technologies." For example, the software share of venture capital rose from 10 percent in 1987 to 22 percent in 1992, and the number of software companies jumped 63 percent, to 214 enterprises, from 1991 to 1992. Many experts say the market has also regained an equilibrium lost in the 1980's — making government intervention doubly strange.

Besides, governments make lousy venture capitalists. Venture capital is about high stakes, rapid change and frequent failures. Success requires dexterity. Washington, however, is hardly known for its speed or ability to manage projects based on prospective economic returns.

Business executives and bureaucrats are driven by very different incentives, not only in selecting projects but also in treating failures. Investors are driven by profit because they have real money at risk. Bureaucrats are driven by constituents because they have elections at risk and because the money they invest is not theirs.

Without financial risk, there is no incentive to be disciplined. If a program goes poorly, the venture capitalist will pull the plug. Would the Government admit a mistake, and fix it, as fast?

Political horse-trading compounds these problems — and the history of the venture-capital provision itself makes the point. When the idea was first proposed, its advocates planned an industry-led program. In 1992, for example, Senator John D. Rockefeller 4th, Democrat of West Virginia, proposed a politically insulated fund sponsored but not run by the Commerce Department. Investment decisions would "remain entirely in the hands of the private consortium," he said.

But a funny thing happened on the way through Congress. First, the venture fund became part of the package to turn the Commerce Department into a high-tech powerhouse. And in March, to break a logjam and a turf battle, the Small Business Administration and the Commerce Department settled on a joint licensing committee. Exit the industry-led approach. Now, under the Senate version, the committee would not only pick which venture capitalists merit taxpayer support but also select the entrepreneurs and even the type of financing the venture capitalists should use!

Over the next month, a House-Senate conference committee will try to reconcile the Senate version of the bill, passed in March, with the version adopted by the House last May. The conferees would do the nation and the competitiveness cause a favor if they asked themselves two basic questions, aptly posed by Senator Bill Bradley, Democrat of New Jersey: "Would you put your own personal money in a Government-run venture capital program? Would you risk your pension funds or your child's education bonds on the ability of bureaucrats to outperform the market?" ■

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Lessons from the Cutting Edge

The HDTV Experience

Cynthia A. Beltz

President Clinton has argued that it is both appropriate and necessary for government "to directly support" and "accelerate the development of technologies critical for long-term economic growth," giving "special attention" to those industries that "are going to explode in the twenty-first century." For those key industries, Laura D'Andrea Tyson, head of the President's Council of Economic Advisers, suggests the government should get into the business of evaluating the likely course of development; compare those baseline projections with visions of what a prosperous national economy should produce; promote domestic development; and monitor the activities of foreign governments and firms.,

Such plans have been used to promote American military interests. But improving the competitive performance of American firms is a fundamentally different task. Commercial success depends not on linear projections of tangible factors such as foreign tank strength, but on such intangible and unmanageable factors as consumer taste for products that don't yet exist, the erratic pace of technological change, and corporate development strategies that often transcend national borders and government control.

To understand how poorly industrial planning performs in this environment, consider the Japanese and European experience with high-definition television (HDTV)—an emerging, multidisciplinary industry that has defied the predictions of experts and the guiding hand of bureaucrats.

HDTV Technology

Technically, HDTV represents the next generation of television. It will replace a 40-year-old standard with crisper, cinema-quality pictures and CD sound. By the nature of its widescreen size, HDTV will make watching television in your living room more like watching a movie in the theater. Much of the technical work has focused on learning how to compress the HDTV signal into small spaces so that the vast amount of information needed to create the sharper images can be sent over the air to consumer sets.

As one of the bridges between television and computers on the information highway, HDTV also represents a new era in consumer electronics. The digital version of HDTV that the United States is pursuing, for example, will transmit pictures using the computer language of ones and zeros. This merging of technologies presents dramatic new opportunities to bring the interactive information age full force into

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Cynthia A. Beltz is a research fellow at the American Enterprise Institute and author of High-Tech Manuevers: The Industrial Policy Lessons of HDTV *(AEI, 1991).*

rior or commercially viable systems before the standard was selected. This missed opportunity left both regions particularly vulnerable to shifts in technology that ultimately proved to be fatal to their HDTV plans.

In the United States, the environment was altogether different: the aim was to shift the technology and the strategy was to rely on competition rather than planning to do so. Five years ago the FCC shot the gun that started the race. Would-be standard bearers were told their proposals must not make the existing stock of consumer sets obsolete and, if possible, to aim for a digital solution. Constant competitive pressure kept the heat on American firms to stretch the bounds of possibility with engineers often disappearing from their families for weeks and then months as they scurried to keep pace with the advances made in rival labs. The result was a continual restructuring of their R&D strategies, culminating in four different digital HDTV proposals.

By relying more on market forces, the United States also managed to keep the relative cost of HDTV development down. As of early 1993, American taxpayers had spent less than $200 million to promote HDTV while taxpayers in Japan and Europe were forced to invest five times as much.

By relying more on market forces, the United States also managed to keep the relative cost of HDTV development down. As of early 1993, American taxpayers had spent less than $200 million to promote HDTV while taxpayers in Japan and Europe were forced to invest five times as much, between $1-2 billion in U.S. dollars, in plans that have now largely been abandoned. Aspiring industrial planners would do well to take note that dollars spent do not equal leadership or success.

Unfortunately, more often than not, this lesson is lost in the debate over critical industries and technologies in Washington. Here it is assumed if Japan and Europe are spending millions in a high-profile joint industry-government R&D program, then they must be ahead of Americans who are "not even in the ball game." It doesn't seem to matter that research has demonstrated that R&D is more cost-effective when financed with private funds rather than with public funds.

Indeed, the point of cost-effective R&D—when investment translates into more benefits than costs—seems to have been lost altogether. Why Washington planners want, for example, to engage in an R&D race with our trading partners to see who can spend the most defies explanation. In business, getting ahead often involves devising systems that spend less—not more—to match or pass beyond your competitors' goals.

Too Much Coordination. Japan and Europe also learned the hard way about the hazards of trying to both chart the "likely course" and accelerate the commercialization of an emerging industry. Japan started developing HDTV over 20 years ago through NHK, which assigned research and production tasks to participating firms. Pushed by the French and Dutch, the European Commission jumped on board in 1986 with their version of high-definition mercantilism, an HDTV plan designed to keep the Japanese out and domestic equipment manufacturers in business.

With industry assistance, government bureaucrats in both regions tried to coordinate all the actors and variables in the HDTV transmission chain so that an attractive product would be available to entice consumers into the market. The range of activities included not only coordinating R&D through public-private consortia, but also developing and testing a transmission system, subsidizing purchases of production equipment and program production, getting an HDTV satellite up and running to deliver the programs, getting sets into the stores, and organizing public demonstrations to spark consumer demand.

At first, government coordination appeared to pay off. Japan registered a series of technical triumphs. Japan was the first to transmit HDTV signals (1979), the first to have its HDTV standard accepted by industry (1984), the first to market with HDTV receivers (1990), and the first to offer HDTV programming in prime time (1991), which the president of Matsushita Electric Industrial Company hailed as "a curtain raiser for the Hi Vision era." HDTV proponents in Europe were also quick to boast about their

Department of Commerce study, which had contemplated spending billions to accelerate HDTV technology, was abandoned and never completed. Craig Fields, who had promoted a national program for HDTV before Congress, was cut out of policy discussions and then later lost his job as Defense Advance Research Project Agency (DARPA) director. Other ideas for special government-created enterprises (like the Consumer Electronics Capital Consortium) were either shelved or listed as dead on arrival at the White House.

The respective decisions of Japan, Europe, and the United States thus put into motion a unique test of opposing views of government's role in promoting high technology. Four years later, the consequences provide a revealing commentary on how planning failed and even an imperfect marketplace can triumph.

The Consequences

Contrary to the forecasts of the doomsayers, American firms were neither left behind nor out of the HDTV race. Instead, in 1992 the United States surpassed Japan in semiconductors and Intel dethroned NEC to become the world's largest chipmaker. In 1992 Japanese electronic makers watched output fall by over 10 percent as U.S. computer manufacturers watched output climb by over 8 percent. For the four top Japanese computer makers (Hitachi, Toshiba, NEC, and Fujitsu), sales and profits continued to fall in 1993 while Intel and Microsoft moved to the forefront as the two most powerful companies in the computer business that are shaping how video will be displayed on future computer screens.

And despite Japan's head start and Europe's deep pockets, American companies now lead in several key areas of HDTV. Ironically, the United States may be the one exporting an HDTV standard to its trading partners. Headlines and press accounts these days proclaim "U.S. Edge in HDTV," "U.S. Passes Japan in HDTV Race," and "Europe Must Now Follow the U.S. in HDTV."

Reasons for U.S. Success, Europe and Japan's Failure

Why this reversal of fortunes? There are many reasons.

No Competition in Standards. What hurt Japan and Europe was their faith in the power of industrial targeting and coordinated plans. Both decided that HDTV was too important to be left to market forces and substituted the judgment of industry experts. Since the Bush administration opposed this type of substitution, U.S.-based firms had to fight for position in the marketplace and for Federal Communications Commission (FCC) approval of an industry standard.

The significance of this role in establishing a competitive environment is too often discounted by those who want government to play a more direct and visible role in commercial affairs.

Yet work by the McKinsey Global Institute suggests that America's secret productivity weapon is not new technology or bigger companies but rather Washington's reluctance to protect companies from the rigors of competition—domestic or foreign. Or, as Michael Porter recently put it in *The Competitive Advantage of Nations*, "few roles of government are more important to the upgrading of an economy than ensuring vigorous domestic rivalry" that fosters not only innovation and other determinants of national advantage but also "checks against forms of government intervention that stifle innovation or blunt competition."

Contrary to the forecasts of the doomsayers, American firms were neither left behind nor out of the HDTV race. Instead, in 1992 the United States surpassed Japan in semiconductors and Intel dethroned NEC to become the world's largest chipmaker.

The HDTV standards contest provides a case in point. In sharp contrast to the American HDTV standards race that involved over 20 different contenders, Japan and Europe each developed a single system (Hi-Vision and HD MAC, respectively) that then was promoted as the industry standard. Competition was actively managed in the early stages in Japan by NHK, the public broadcasting company, and actively discouraged in Europe by a series of EC directives. Isolated from the pressures of competition, engineers were not forced to develop supe-

America's living rooms. Over the long term, HDTV might become a vehicle for new services such as telecommuting, home video conferences, and on-line reference libraries of video recordings.

But by blurring the traditional industry lines, technologies like HDTV magnify the complexity of the planning matrix. To chart out the likely course for HDTV and to design programs to encourage domestic production, for example, planners would need to speculate about user demand and input supply conditions not only in television, but also in computers and telecommunications.

At the height of the debate in 1989, there were seven HDTV bills before Congress, over 10 different committees were holding hearings, and countless reports from special interest groups and blue-ribbon commissions were circulating in Washington.

The Choice

Unlike most innovations, HDTV has led an active, controversial public life. From its beginning HDTV was held up in Washington as one of those rare "industries that have the potential to dominate the twenty-first century." Government direct support was held to be necessary and vital to American economic interests. At the height of the debate in 1989, there were seven HDTV bills before Congress, over 10 different committees were holding hearings, and countless reports from special interest groups and blue-ribbon commissions were circulating in Washington.

Much more than a technical issue, in the words of then-Senator Albert Gore (D-Tenn.), "HDTV has become a political dividing line, where opposing conceptions of government meet." On one side are those who put their faith in coordinated plans, supported by public funds and the advice of experts, to develop critical technologies that they believe should not be left to an imperfect market to develop. On the other side are those who believe that such plans are inherently imperfect and out of step with the emerging high-tech order, and that government support is more effective when focused on creating an environment that promotes the competitive forces of the market.

The Japanese and European HDTV strategies provide instructive examples of the planning mentality. Indeed, both were held up in the late 1980s as models for what an American competitiveness policy should emphasize: strategic long-term planning at the national level, coordinated and collaborative precompetitive R&D, and strong public support through the commercialization stage.

HDTV thus became an important test case. For Japan, HDTV represented an opportunity to transform its image from a follower to an innovator in high technology. For the European Community (EC), HDTV was the flagship of its new technology policy under the 1986 Single Market Act. For the United States, HDTV represented the policy of the Bush administration to emphasize the market.

The American debate was often heated, driven by the fear that this country would lose its competitive edge unless it kept pace with the spending and planning programs of its trading partners. Back in 1989 a parade of industry "experts" testified on the dire need for America to wake up and match the efforts of Japan and Europe in HDTV. Because both regions had already set their HDTV standards and were spending millions to commercialize it, such industry heavyweights as Zenith and the American Electronics Association (AEA) argued that without a comparable program the United States would be left behind in the global high-tech race.

"If the United States does not choose to reenter consumer electronics via HDTV," warned the AEA, "the country as a whole is likely to continue to experience a declining world market share in automated manufacturing equipment, personal computers, and semiconductors. Loss of these markets will contribute to the erosion and eventual loss of a U.S. manufacturing base." To avoid this catastrophe, industry representatives called for a "well-coordinated" $1.3 billion HDTV program that included public-private consortia, federal grants, loan guarantees, nurturing of infant industries, and guaranteed procurement contracts to promote prototype development and domestic production.

The Bush administration rejected the plan. The technical accomplishments. The European Association of Consumer Electronic Manufacturers claimed that with its MAC system Europe had a five-year lead on its foreign HDTV rivals and was on the verge of having the world's finest television system. Unfortunately, European taxpayers soon discovered that commercial success requires much more than a working prototype.

The industrial planners in Japan and Europe underestimated the complexity of the high-tech food chain and overestimated their ability to coordinate producers and to play the role of consumers. In Europe, for example, equipment manufacturers complained they were unable to provide consumers with MAC receivers because the downstream chip industry was too slow in developing the components. Whereas in Japan, HDTV sets were available but consumers were not. For an average consumer, it is easy to understand why. The selection of HDTV programs is limited, only eight hours of programming is available each day, and sets are selling for between $7,000 and $10,000.

Once cheap, lightweight, large flat-panel screens arrive, consumer interest could pick up dramatically. But the necessary advances in flat-panel displays and manufacturing technologies have been disappointingly slow. Meanwhile, to the exasperation of engineers and bureaucrats, consumers seem to be more interested in program quality and choice than high definition. Consumer interest in HDTV may be further diluted by a growing list of home entertainment and computing options that includes digital, widescreen services with up to 500 possible TV channels promised by 1995; cable radio with CD sound; and interactive video services delivered by a growing web of multimedia providers (cable and software firms, regional Bell companies, and so forth).

Japan and Europe were also surprised by the digital revolution and the pace of technological advance in transmission technologies. Rather than tackle the problem of squeezing the HDTV signal into the narrow band needed for over the air delivery, both tried to rush to the marketplace by relying instead on direct-to-home-satellite broadcasts and the analog-based technology of conventional television. Both were stopped in their tracks by supply-side problems. First, because of a series of launch failures and mechanical problems, they had trouble getting the necessary satellites in place. Then there was the problem of getting the broadcasting community to fall in line.

European planners thought, for example, that they had locked in their analog standard in 1986 when they required all high-powered TV satellite broadcasts to use MAC. They were wrong. Technical advances and the successful launch of the Astra satellite in 1988 made it possible to transmit TV signals from medium-power satellites which were not covered by the directive. Efforts to dissuade commercial broadcasters, who were all too eager to circumvent Brussels' regulatory reach, from exploiting this loophole failed. In 1989 media tycoon Rupert Murdoch passed over MAC to broadcast Sky Television, the first privately funded satellite service, in the conventional Pal format. He added insult to injury one year later when Sky took over the only commercial user of MAC, British Satellite Broadcasting, thereby crushing MAC hopes in the United Kingdom.

Most industry experts dismissed digital television as a distant possibility that posed no threat to analog-based HDTV systems. They were wrong.

Digital transmission, in contrast to the Hi-Vision and MAC systems, is compatible with terrestrial broadcasting. It promises to resolve the signal compression problem and to thereby reach more households: 80 percent of European homes receive their signals from terrestrial transmitters. Most industry experts, however, dismissed digital television as a distant possibility that posed no threat to analog-based HDTV systems. They were wrong.

Driven by market pressures, the American firm General Instrument shocked the experts and changed the rules of the game in 1990 when it presented its digital HDTV system for FCC testing. Not to be outdone, General Instrument's rivals hurried back to the labs, and within six months four digital HDTV systems were on the table for FCC consideration. Since then, investors and policymakers worldwide have been forced to confront the prospect of digital HDTV coming on stream at the same time as analog-based systems.

As a result of those unforeseen market and technology developments, Japan's much-celebrated advantage in HDTV has proven to be at best a hollow victory for long-term strategic planning. The analog system that Japan spent 20 years developing has been a commercial failure. By 1993, only 10,000 sets have been sold; industry and government experts had predicted that consumers would buy over 1.3 million sets. Manufacturers have defected from the Hi-Vision system and dramatically scaled back their mass market dreams. Japanese manufacturers are also in the unexpected position of scrambling to catch up to the United States in digital transmission and processing technologies.

The European experience with HDTV was equally disappointing. Heavy subsidies succeeded only in producing an unpopular system that became obsolete before it was fully implemented.

An Inflexible Response. The failure to anticipate market and technology trends was, however, only one part of the problem. A rigid response to these trends when they became apparent was the other. Major technical and political reputations were staked on the success of the respective Japanese and European plans, making any retreat difficult. Both regions fell victim to the dilemma facing a bride and groom ready to walk down the aisle surrounded by their friends and business associates. Suddenly it becomes clear that they are not compatible. Do they continue the walk out of obligation and fear of embarrassment? Or do they acknowledge the change, cut their losses, and thereby limit the long-term damage?

As a result of unforeseen market and technology developments, Japan's much-celebrated advantage in HDTV has proven to be at best a hollow victory for long-term strategic planning. The analog system that Japan spent 20 years developing has been a commercial failure.

In Europe, equipment manufactures went for the first option. They wanted to protect their investments in analog HDTV and were unwilling to respond to the incompatible digital advances emerging from American and European laboratories (such as National Transcommunications and HD-Divine). Rather than suffer severe political embarrassment, the Commission for three years after the General Instruments breakthrough also resisted letting go of its incompatible approach to the marketplace. Through 1992 the Commission continued trying to marry its MAC strategy to an unwilling market with proposals to close the satellite loophole and a $1 billion dollar action plan.

Both proposals were beaten back by opponents in the United Kingdom, consumer groups, and commercial broadcasters like the French company Canal Plus. Andre Rouselet, the head of Canal Plus, humiliated planners in Paris and Brussels last fall when he announced that "MAC is dead" and digital is the way forward. The demonstration and slogan from the Scandinavian HD-Divine group, "digital terrestrial HDTV before the year 2000," also mocked the EC claim that digital would not be possible until the twenty-first century. EC officials finally conceded commercial and regulatory defeat last spring when they cut their losses and abandoned their seven-year-old MAC HDTV strategy.

Japan's strategic retreat was somewhat faster and almost silent by comparison. As one chip maker put it in 1992, "Officially, nobody can tell you the future is digital because we Japanese spent too much money to develop analog HDTV." The closest official pronouncement came in June 1992 when Kazuhiku Nishi, a member of an industry advisory group to the Ministry of Postal and Telecommunications (one of the major HDTV players in Japan), was permitted to tell an Massachusetts Institute of Technology symposium that consumer demand for "personalized television (remote theater and interactive services) requires a strategic retreat" from analog HDTV. Japanese firms are now openly focused on digital research and forming partnerships with foreign firms to develop an international standard.

What the Europeans will do next is less clear. Stung by the failure of its HDTV strategy, the EC is going through an intensive internal review of its technology policies. The new EC commissioner in charge of HDTV, Martin Bangermann, is also pushing the EC to change course and accept global (rather than idiosyncratic) standards, even if it requires accepting American digital technology as the basis for that family of standards.

But protectionist and regulatory tendencies die hard in Brussels. The EC has put together a European Launch Group for Digital Video Broadcasting that is led by the German Postal, Telegraph, and Telephone Administration. The goal is a European digital standard supported by an action (subsidy) plan. The approach follows the flawed MAC approach: first collaborate to get a politically acceptable standard, try to impose the standard on the market with another mandatory directive, and then develop the hardware. Competition and diversity are not high on the list of priorities.

Technology and market developments in pay TV and satellite services also seem likely to overtake whatever standard the group finally accepts. Canal Plus and Murdoch's News Corp are not waiting for the EC. Instead they are already working together and with American firms to introduce digital, multichannel services by the mid-1990s while bureaucrats in Bonn, Brussels, and Paris were still busy burying MAC. Ironically, the EC has demonstrated that gridlock can be good. Indeed, the EC's slow pace may be Europe's secret productivity weapon if it allows, as in the HD MAC case, the private sector time to develop rival strategies. Those strategies then may serve as ammunition to check the plans of Brussels' bureaucrats that threaten to stifle innovation or blunt competition.

The United States should also be wary about becoming inflexible. Though it took an indirect approach to the first major step of HDTV's commercial development, regulators are involved and there is the risk of the United States' becoming too attached to an HDTV vision that may not match the market's timeline. To its credit, the FCC has adjusted its original timeline for an HDTV terrestrial standard several times to take into account the need for participants to upgrade their systems after the first round of testing. Equal or more caution seems in order when implementing whatever system is selected so that the interaction of consumers and the broadcasting community (rather than regulators) determines whether the market is ready for HDTV. Like that of the EC, the influence of the FCC may be curbed by market developments in cable and satellite distribution that preempt its choice for a transmission standard.

Mozart writing the digital version of his symphony No 38 in D major

Industrial policy advocates still don't get it: government targeting is not keeping pace with the high-tech marketplace. Predicting the future and which individual industries are going to "dominate the twenty-first century" has even the experts confused.

HDTV Lessons for the United States

There is little indication that Washington has learned anything from the HDTV experiment in opposing conceptions of government. Japan and Europe are victims of their faith in industrial planning. Yet Bush's "just say no" stance to industrial targeting has been replaced by Clinton's "let's take a look." And a report on HDTV from the private Council on Competitiveness suggests, for instance, that more (not less) coordination and planning by

Economic nationalism is out of step with a world in which information, money, and technology can zip around the world with little regard for the tools of national economic management. There is nothing about a standard that would prevent a Sony, a Samsung, or a Hitachi from building boxes that are better than sets made by American or European firms. There is also no guarantee that government research support will translate into domestic production. There is no guarantee that the company or country that advances and owns a technology will do the manufacturing. There is also no guarantee against something better coming along before the technology reaches the commercial product market.

This world of HDTV and other advanced technology products will be marked not by national boundaries, but by a bewildering web of international research, trade, investment, and production relationships. Already in HDTV international alliances have formed between European, American, and Japanese firms in fields ranging from chips and displays to transmission technologies and information systems (see chart).

Driven by competitive imperatives (to pool risk, exploit complimentary strengths, and explore new markets), major corporations are developing global strategies and international alliances at an unprecedented pace—more than 900 reported since the mid-1980s. To make matters more confusing for would-be planners, a rising portion of foreign trade—over 50 percent by some estimates—is not international commerce in the traditional sense, but transfers across national borders within a single company such as IBM or Texas Instruments.

This system of complex interdependence doesn't lend itself to easy definitions of an American firm, an American technology, or even an American product. Like today's autos, tomorrow's HDTVs and other advanced technology products will include designs, software, and components from around the world—often themselves the result of an international alliance. As John Young of Hewlett Packard put it, "whatever the technology that is developed, in whatever country, we'll be going after it for our products."

Transfers of knowledge, investments, and engineers within firms and across borders are essential to technological advancement and are at odds with the nationalist notion of technology as a physical asset that should be grown and kept at home. Europe learned this lesson the hard way in HDTV. It is time for economic nationalists in the United States to learn from their mistakes. Outdated notions of high-tech planning should be given a rest.

In an imperfect world with few guarantees, a more pragmatic strategy is needed: focus on what you know works and what you have a chance of controlling. If advancing a technology is the objective, HDTV has proved the value of promoting competition. If boosting national prosperity is the objective, the high-tech arena growing up around HDTV and other critical technologies suggests that the success of an individual firm or technology is the wrong place for government to look. Both are internationally mobile and increasingly beyond federal control.

Let's stop daydreaming about industrial planning and wake up to the new realities (dare we say opportunities?) of high-tech competition. Perhaps then sensible, practical policies that can move the nation forward will have a fighting chance.

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Selected HDTV and Information Technology Alliances

HDTV Chips

Motorola — Toshiba
Texas Instruments — Fujitsu, NHK, Sony, Hitachi
LSI Logic — Sanyo
LSI Logic, VLSI — 10 Japanese Companies including Matsushita Electric Industrial Co., NEC, Mitsubishi, Sharp, Pioneer, E1, and Victor

Flat Panel and HDTV Displays

Applied Materials — Toshiba, Sharp
IBM — Toshiba

Risc Chips

Sun Microsystems — Fujitsu, Toshiba
MIPS — NEC, Sony
HP — Hitachi, Oki

Other Semiconductors

Intel — Sharp (flash memories)
AT&T — NEC (DRAMS)
TI — Hitachi (DRAMS)
IBM — Toshiba, Siemens (DRAMS)

Consumer Electronics/Computers

Apple — Sharp (personal digital assistants)
AT&T — Matsushita, NEC, Toshiba
Apple, AT&T, Motorola — Sony, Matsushita, Philips (software standards)
Kaleida Labs — Mitsubishi, Hitachi, Toshiba

Interactive Media

Sega Enterprise — Time Warner and Telecommunications to deliver videogames via cable
Fujitsu — negotiating with RBOCs to provide advanced switching equipment for video-on-demand services
Toshiba — Scientific Atlanta to develop high capacity terminals for interactive system

experts will let the United States avoid the mistakes made abroad in HDTV. The apparent hope is that, by requiring consultations between industry and federal agencies, only the best plans for strategic industries will be supported with public funds.

Industrial policy advocates still don't get it: government targeting is not keeping pace with the high-tech marketplace. Predicting the future and which individual industries are going to "dominate the twenty-first century" has even industry experts confused. AT&T Chairman Robert Allen has remarked that "the industries—computer, communications, and entertainment—are all moving so fast that I can't be knowledgeable as to where they are all going or where they'll all converge." The range of digital possibilities is so puzzling that many, like AT&T, have abandoned efforts to focus on any one technology like HDTV. Would-be strategic planners in Washington should take note.

An important lesson from HDTV, that one would have hoped would be obvious to the U.S. government, is that competition works. In HDTV, the case of even coordinated government plans made in the early 1980s failed. The United States showed that pushing competition over collaboration can advance technologies beyond the limits industry experts considered possible. The duplication of effort was more than offset by the exploration of different approaches that increased the rate of technological progress and the spillovers for a range of firms in digital information technologies.

The U.S. experience in HDTV provides a home-grown model and a practical strategy that could work for whatever technologies are deemed to be worthy of "special attention." It could also provide a needed dose of humility for Washington's aspiring industrial planners.

Congressional pressure to do more will no doubt continue. But the Clinton administration should heed a second warning in HDTV about the increasingly global nature of many high-technology industries and the difficulties of designing more active policies to foster national participation. Efforts like Europe's to use standards and subsidies to limit foreign competition are increasingly prone to failure as they collide with the unpleasant realities of global competition

Mr. GUTKNECHT [PRESIDING]. Dr. Hudgins?

STATEMENT OF DR. EDWARD HUDGINS, DIRECTOR OF REGULATORY STUDIES, CATO INSTITUTE, WASHINGTON, D.C.

Dr. HUDGINS. Thanks a lot. By the way, I am also the Senior Editor of Regulation Magazine in which you published your study on HDTV.

I want to thank the committee, first of all, for the opportunity to testify. I will just focus very briefly on some of my main problems I have mainly with the ATP is what I am focusing on here.

First of all, a kind of conceptual problem. These handouts are often justified by the fallacy of focusing simply on the recipients of the handouts.

Now bureaucrats handing out taxpayers' dollars often justify their program based on two facts.

Number one, that the recipients of funds like the fact that they are getting the funds;

Number two, that the recipients spend the money on something which most people would approve of.

But the problem is, this is not necessarily a good way to do government policy. You can literally justify dropping money from a plane over Washington, D.C., and tracing each dollar to a particular recipient.

You would find the recipients, number one, like the fact that they are receiving a free good.

And, number two, you would probably find that they spend the money on things of which we would approve—for example, food, new shoes, perhaps they would invest it in their laundromat or their small enterprise and we would all applaud them for that. This is not necessarily a good public policy.

By the way, I would add, incidentally, that the government would probably take credit for everyone's prosperity who picked up a few dollars because they had spread it around.

And number four, this approach would not account for alternative uses of the funds, which actually does get into some of the things we are talking about today more specifically.

A second problem, or issue, I would say, the markets do in fact work very well. In addition to what Cynthia has mentioned, I would point out the fact that the pharmaceutical industry now spends about $390 million to bring a new product to market over a five to seven year period.

Now I just use that as an example that businessmen often do look long term.

Number three, bureaucrats have no unique abilities better than those of private investors or entrepreneurs to pick winners and losers.

It is not by virtue of their keen ability to spot future market needs, or their creative talents for inventing new products or services, that bureaucrats disperse government—that is, taxpayers funds.

Now you will often find winners and losers. In the free market you will find certain enterprises that come up with great ideas that are never taken up. You also find lots of enterprises that get money, and the investment turns out to be bad.

The point is, there is no evidence that federal bureaucrats, whether with expert boards or not, can do this better than the private sector. Now let me be blunt here.

If the bureaucrats and the political appointees have such abilities, they will go ahead and start a consortium, raise a couple hundred million dollars, pass it out and make a lot of money. If they can't do that, then I am sort of dubious to think they can do it with government money.

Fourth, if you look at the record of government-directed investment you find it is not particularly good.

In the 1970s—and I think these numbers actually go into the 1980s when I did them originally a couple of years ago—the Commerce Department issued $1.23 billion in loans and in loan guarantees of various sorts.

Not even half were paid back. The Economic Development Administration lent out $471 million.

They have received $60 million in paybacks to date, and the amounts that they are carrying on the books are probably grossly overstated.

I point out that in the 1960s a critical technology demanding government assistance was the Supersonic Transport Plane. The Federal Government spent $920 million on that before they mercifully killed the project.

The Europeans put a lot of money into it. They now have a Supersonic Transport Plane.

The French and the British still have not broken even. They still have not paid off all of their investment cost. It was a boondoggle. HDTV is another example.

By the way, I point out that the Europeans do not export personal computers and software to us not because we have trade barriers, but because our entrepreneurs were better. They were busy funneling investment dollars into other things. The point is, the record is mixed at best.

Another thing I will mention, a problem, as has been mentioned earlier by one of the Members, is that a lot of these funds I would classify as "corporate pork."

3M received over five years $6.1 million; BP Chemicals—these are the 1994 numbers—$5.2 million over four years; Caterpillar, $3 million over three years; Texas Instruments, $2.2 million over 28 months; DuPont Fibers, $9.6 million over five years; IBM $1.9 million over three years; and so forth.

The point being that a lot of this can only be classified as corporate pork. Mr. Reich has called it that, and I hope the Administration will take this into account.

Since I am coming to the end of my time, I just want to finish up by calling your attention to testimony before this subcommittee two years ago, specifically on March 25th, 1993, by Dr. T.J. Rogers, the president and CEO of Cypress Semiconductor.

Dr. Rogers pointed out before this committee that his company stood to make a lot of money if we followed through on many of the proposals that the Clinton Administration was putting forward at that time.

Mr. Rogers then came out and said, we do not want your help, we do not want your money, and explained why in the testimony at that time. He basically gave some of the reasons I have given, as well.

This is not in my written remarks, but I will just end by saying we do have a problem in this country with over-regulation of industry.

Deregulation dealing with the liability problem and so forth will not necessarily guarantee that any given entrepreneur will be able to fund his project, but it will bring down the cost, and indeed it will help to enlarge the capital pool, and I think it will allow businesses to take more risks and to make better investments and to keep us on the cutting edge of technology.

I thank you for your attention.

[The prepared statement of Dr. Hudgins follows.]

TESTIMONY
Dr. Edward L. Hudgins
Director of Regulatory Studies
Cato Institute

U.S. House of Representatives
Committee on Science
Subcommittee on Technology
On the Advanced Technology Program
March 23, 1995

I want to thank the committee for the opportunity to testify today on proposed expenditures for the Commerce Department's National Institute of Standards and Technology.

The Clinton administration is seeking $491 million for the Advanced Technology Program (ATP) for FY 1996, up from the $431 million in projected expenditures for FY 1995. Further, the administration is seeking $147 million for the Manufacturing Extension Partnership (MEP) for FY 1996, up from some $91 million in the current fiscal year.

These expenditures are examples of unneeded corporate welfare, wasted in a market that already produces world-class technology. It is of such expenditures that budget deficits measured in the hundreds of billions of dollars are made.

I suggest that the correct level of expenditure for these programs is zero. The reasons why are as follows:

1) These handouts are justified by the fallacy of focusing on the recipients.

Bureaucrats handing out other people's money often justify their programs based on two facts: First, that the recipients of the funds approve of the handouts; and second, that the recipients spend that money on something of which most people approve. And I suspect much of the testimony that you will hear in favor of the ATP and MEP will be based on--I would say bogged down in--these two facts.

But these facts are true almost by definition for every federal government handout. Most individuals receiving free goods are pleased to have them and would like the handouts to continue. If one dropped money from a plane over Washington and traced each dollar, one would find first that everyone picking up the money was happy to have it, and, second, that most individuals spend the money in ways we approve, for example, to purchase food or shoes, or to invest in a small business. But this would not be good public policy.

If these are the only arguments in favor of a particular government expenditure, including the ATP and MEP, they are not sufficient.

2) The market works well without government handouts.

The private sector is the principal engine of this country's multi-trillion dollar economy, not government handouts. In the area of advanced commercial technologies, that is, the high-tech revolution of the past 15 years, the private sector already does a world-class job in developing new products and technologies. Thus, ATP is unnecessary.

The way a market system--as opposed to a corporatist or socialist system--works is that if there is a prospect for a profit, entrepreneurs will risk investing in order to reap profits. For example, the cost of bringing a new pharmaceutical product to market is now on average $390 million. Yet drug companies make such investments. If there is a profit to be made, entrepreneurs will act with or without government handouts.

3) Bureaucrats have no special talent for picking winners and losers.

Federal bureaucrats have no unique abilities, better than those of private investors and entrepreneurs, to pick winning companies and technologies. It is not by virtue of their keen abilities to spot future market needs or their creative talents for inventing new products or services that bureaucrats acquire power to disburse investment funds. It is by virtue of their ability to function well in a rule-bound organization that is insulated from market forces, or their ability to secure a political appointment. If anything, one should suspect that the capacities that make for successful bureaucrats and politicians would make dull, incompetent entrepreneurs.

To put it bluntly, if bureaucrats and political appointees did have special abilities to pick winners and losers, they would become entrepreneurs or would work for entrepreneurs, and actually produce the new products for which they claim consumers clamor. They would put their own money, not taxpayers', and their creativity and energy, where their mouths are.

It is important to note that bureaucrats tend not to discover the Steve Jobs and the Bill Gates of the world.

4) The government's record of success in subsidizing enterprises is abysmal.

Here are offered but a few example of this history.

*In the 1970s Department of Commerce, which oversees ATP and MEP, issued $1.23 billion in loans and loan guarantees through various programs. Not even half were paid back. The American taxpayers lost over $650 million. And those loans still carried on the books are of questionable value. For example, the Economic Development Administration at Commerce, which lent $471 million in the 1970s but has recovered only $60 million to date, recently sought congressional approval to sell off some of its bad loans for less than ten cents on the dollar.

*On the more focused issue of advanced technology, recall that the Supersonic Transport (SST) plane in the 1960s was considered a "crucial" commercial technology and gobbled up $920 million in taxpayer dollars. The result: Congress mercifully put the project out of its misery in 1973. The benefit to the public: None. By contrast, the governments of France and Britain continued to fund their SST. Now they operate a few of these planes at a huge loss and have not even come close to covering the costs of development.

*High Definition Television (HDTV) is one of the clearest failures of the government's targeted handouts. Japanese businesses, with subsidies that totaled $1 billion from their government, in the late 1980s sought to develop HDTV using existing analog technology. Thomson Consumer Electronics of France, a subsidiary of that country's state-owned Thomson S.A., received around $1 billion to develop a similar system. American firms sought, but were denied by the Bush administration, $1.2 billion in subsidies to compete with these foreign rivals. The U.S. government in the end probably spent $200 million for miscellaneous research and feasibility studies. As a result of being denied massive subsidies, American companies were forced to develop an even better, more efficient form of HDTV.

*Zenith and American Telephone and Telegraph invented a fully digital system that made the analog Japanese and European systems obsolete before they even went into production. Japan has announced that it will abandon its system, losing its $1 billion in government funds and private investment, and adopt the American system. The French firm also lost over $1 billion. If the Bush administration had listened to those seeking subsidies, all countries would be working with inferior technologies, and American firms would be just a few among the many mediocre.

5) The ATP is indeed a high-tech version of the Small

Business Administration (SBA): wasteful and counterproductive.

The ATP has been called a high-tech version of the SBA. This is a good analogy because SBA has an abysmal record, with a default rate of around 20 percent. Some 99.8 percent of American small businesses do not receive SBA assistance. As long ago as 1963 Life magazine described SBA as "an almost brand-new device for soaking up money and getting rid of it."

6) The proposed ATP expenditures are the kind of corporate welfare against which the Clinton administration inveighs.

Even when an investment does promise to pay off and there are willing private investors, businesses often are still willing to defray expenses by accepting handouts taken from taxpayers; and the federal government is willing to transfer such funds so that politicos can curry favor with recipients and claim to be friends of business. Labor Secretary Robert Reich correctly denounces such handouts as corporate welfare. Yet the Clinton administration still wishes to hand out such welfare through ATP. Among the 1994 recipients of corporate welfare:

*3M-3M Center received 6.1 million over five years to develop film technologies to replace aircraft paint;

*BP Chemicals received $5.2 million over four years to develop dual-purpose ceramic membranes;

*Caterpillar Inc. received $3 million over three years to develop engineered surfaces for rolling and sliding contacts;

*Texas Instruments received $2.2 million over 28 months for a single-chip receiver front-end with integrated filters, and $2 million over three years for ultra-low k dielectric materials for high-performance interconnects;

*DuPont Fibers received $9.6 million over five years for thermoplastic composites for structural applications;

*IBM received $1.9 million over three years for a framework for enhancing computer-integrated manufacturing;

*Xerox Corporation received $1.8 million over three years for reusable performance-critical software components.

These are hardly new, poverty-stricken, desperately struggling businesses that cannot fend for themselves without corporate welfare.

7) The funding decisions for these handouts are often based on political concerns.

The list above of large corporations receiving funds is enough to suggest that political influence plays a part in distributing largess.

8) Some businessmen do realize that corporate welfare in the end only harms them and the economy.

On March 25, 1993 Dr. T.J. Rodgers. President and CEO of Cypress Semiconductor Corp. testified before the House Committee on Science, Space and Technology, Subcommittee on Technology, Environment and Aviation on government subsidies for high-tech innovations. After showing several of his company's products, Rodgers observed that "we would benefit greatly if billions of taxpayer dollars were showered on the various technology projects favored by the Clinton administration." He then made his main point:

> But I am here to say that such subsidies will hurt my company and our industry. Why? Because they represent tax-and-spend economics--a brand of economics that is a known failure. I do not want handouts. The men and women of our

company do not want handouts. And if Congress wants to help American high technology, handouts are the wrong way to go.

This is the attitude that businesses and Congress should take towards technology policy. I call your attention to this testimony.

9) The U.S. Constitution does not allow for government subsidies of private commercial endeavors.

I realize that to bring up the U.S. Constitution in the U.S. Congress is a bit of an anachronism. But I believe that if we are to reestablish a republic of limited government in this country, we must refer to the law upon which it was and should be based.

Article I, section 8, [3] of the Constitution gives Congress the power "To regulate Commerce ... among the several States..." This was meant to allow the federal government to remove trade barriers between states. In this century the federal government has used--I should say misused--this power to regulate the way entrepreneurs actually run their enterprises. But it is an unreasonable stretch to maintain that this paragraph implies that the government regulates by passing out taxpayer dollars to favorite industries.

Article I, section 8, gives Congress the power "To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries." This quite clearly refers to protection of intellectual property rights, not to passing out checks to favored industries.

Summary

The bottom line is that federal government handouts to businesses through the ATP are not needed. The kind of government-business partnerships promoted by the MEP have some unique problems of their own but, on the whole, the above criticisms apply to these as well.

If Congress is to cut federal spending, subsidies like these should go. And if the Clinton administration is to cut corporate pork and welfare, it should join Congress in these cuts.

Mr. GUTKNECHT. Thank you, Dr. Hudgins.

We have got to go over and vote. So I am going to call a recess for 15 minutes. I noticed when you were talking, some of the panelists on your left were wrinkling their noses.

The first question I am going to ask when we come back is for some of the other folks to respond to some of the points that you have made.

So we are going to take a 15-minute recess so the Members can vote and you can catch your breath.

[Recess.]

Mr. GUTKNECHT [PRESIDING]. I will call the committee back to order.

Before we had to recess, I indicated that I noticed that several of the panelists were wrinkling their noses with some of the comments from Ms. Beltz and Dr. Hudgins.

I am wondering if any of you would like to respond to some of the comments they made before we broke relative to, and I think one of the interesting comments was first of all about the high density television and the rush several years ago for federal grant money to go forward with that.

Then, secondly, just in terms of whether or not we would invest our own pension funds in some of these ideas and how you would respond. Perhaps, Mr. Carlson, would you like to respond?

Mr. CARLSON. Thank you.

For those of us who have had the opportunity to be involved in international competition for the last 20 years or so in Europe and Asia, you soon recognize that international competition is a team sport.

To the extent the U.S. has a team, and the Japanese have a team, and the Germans have a team, we need to look at every element of our team and it has to be effective. Government is certainly a part of any international team today.

So whether or not government is a player on the team, that is not even an issue. It is whether or not your government is effective on your team.

As far as whether or not we would invest our own money, we are investing our own money. In the ATP, we invest more than what the Federal Government invests.

As to whether or not the private sector can do this on their own, our experience over 10 years of trying to put together such a coalition in Michigan focusing on competitiveness of the auto industry, we could not.

With the NIST assistance—and NIST is very experienced at putting this type of research collaboration together; we do not have that experience in the private sector. So it is not a question of whether it will be successful or not. We are in our third year.

I can speak from first-hand experience as an entrepreneur. This is tremendously successful. I can take you to a number of automotive manufacturing plants in America where we have already implemented some of the results of the research, and it is empowering to see workers in these plants utilizing the ideas and the techniques that we have developed.

So as to whether or not it is working, the results are in. It is tremendously successful.

Mr. GUTKNECHT. Yes, Mr. Caisse.

Mr. CAISSE. Relative to would you put your own pension fund in, those of us who are entrepreneurs have put, as Mr. Gibson said, sometimes their homes, quite often their health and their family as investments into these things. So the answer is a resounding "yes" from those of us who live there.

And would we do it again? Probably true.

Relative to the ability of the government to pick winners and losers to invest in things like HDTV, you can easily find many places where mistakes have been made not only in government's choices but in venture capital.

The average rate of a hit for a venture capitalist is about 1 in 10. Those are for the lower-risk ventures that they go after.

If you consider the type of investment that ATP is backing where the windows are 5, to 7, to 20 years out, you are looking at much higher risk. You can probably expect lower returns than 1 in 10. The fact of the matter is, however, that the potential return on those investments are so high that they still make them a very, very good opportunity.

The question I see is it is not who gets the money, or who goes after a product, it is what gets gone after. The short-term investments that are being made now are what are responsible for the banner years that were mentioned.

That is catch-up. What we need to be concerned with in America is what is ten years out?

If we are investing in next year's profits, which corporations do, and have, and are doing well right now, is it at the expense of the long term?

Ms. BELTZ. Can I just clarify something?

My question on the pension funds was a question relative to the inherent incentive problem with the government technology policy programs. The idea was for Members of Congress to be asked that question.

Would you invest your funds? And would you bet on the ability of the government to out-perform the market, whether it be through an ATP program or not.

I have great admiration for the different entrepreneurs in our economy. I have spent time talking with folks, too.

It is clear that there are great sacrifices when you believe in your inventions and things like that. It was not meant to be a question to the panel. So I wanted that as a point of clarification, because the context of that question is government is playing with taxpayer funds, not their own funds.

The other second point, real quick there, with respect to there is a difference between the structure of the government the way it is organized and a venture capital firm which has inherently evolved to be able to deal with extremely risky business propositions, and to be able to respond to that flexibly.

Mr. GUTKNECHT. Well I would really like to get back—maybe Ms. Conner or Mr. Gibson could talk—I mean, I do remember the discussion. I am a freshman here, but I remember when everyone was—we read a lot at least about the high density television, and that the Federal Government had to make that a top priority. Any response to that?

Mr. GIBSON. I would like to respond to that, and a couple of the other items, and I will do so very briefly.

One of the issues is that for high definition television, if one is talking of backing a large consortium then that is exactly the kind of project which the ATP is trying to stay away from. They are in general trying to make a large number of very small bets, as opposed to trying to bet exactly which way the technology is going to go.

For example, if one takes a look at a billion dollar program, within the Advanced Technology Program, at least in the single-company applicants, instead of making one big bet they would be making 500 small bets, and sometimes multiple avenues of what was going to be successful because they would not be trying to predict ahead of time which one would work.

Going on, the comment from T.A. Rogers who has clearly been extremely success in Cypress Semiconductor, I have with me a copy of part of his testimony before this subcommittee in March of 1993. I think it is fairly illustrative.

He said. "I own shares in Silicon Graphics. It exists because of hundreds of institutions and wealthy individuals like me who put their money into the company through venture capital. Washington cannot create more companies like Silicon Graphics."

Now that is a pretty strong statement. I do not want to argue that venture capital is not necessary, or private investment is necessary, because it clearly is absolutely essential. It is what finally makes things move to the product stage when people can evaluate whether there really is a market opportunity.

I would like to quote also from Electronic News, April 30th, 1990, three years before T.J. Rogers, where there is a quote:

"DARPA provided the precompetitive funding that made possible such high-technology successes as Silicon Graphics and Sun Microsystems.

The key here is the government was making a lot of small bets through the ARPA program at that time, and they took care of some of the initial technical issues that made it possible for the venture capitalist to even evaluate whether this was worthwhile to sink the large number of dollars in it takes to actually get it to the marketplace.

I would suggest that what the ATP is doing is playing that role. They are putting the early dollars that sort of demonstrate the technologies so that one can evaluate for the VCs and others whether they should put in the much larger dollars to actually move it forward.

Ms. CONNER. And another comment I would like to make regarding the HDTV program is we do not advocate focusing a lot of ATP monies in key areas.

One of the things that I think is really important, if you see the continuum of technology companies, or technology investment program that exist from the very centralized, monolithic structural political organizations such as ARPA, which is great for defense development but is not very useful for commercial development, to the other side of the continuum which is NCMS, the National Center for Manufacturing Sciences which is more market-driven, pluralistic, commercially oriented collaborative process where the companies make the decision.

I think NIST, the ATP program, is somewhere in the middle of that. So in general we support the program. We just think it needs to move us as closer to the market-driven side as possible so that you have a number of different programs that are funded and not just in certain areas.

Mr. HUDGINS. Can I just respond very quickly?

This is a good observation. The problem is this. If you go back 15 years ago and take a look at what was the common knowledge that, well, these are programs and technologies and so forth that the private sector would never invest in, therefore the government has to get into it, let's have hearings on, you know, where are we now?

What was the wisdom like in the government 15 years ago? Let's look at all the failures, as well.

To the extent that the government program could approach what the market would do, in a sense the argument is, well, the market will do it. And in fact, in some of these process technologies what you've found over the last three or four years or more is that businesses have been getting into alliances to invest in long-term technologies, process technologies, and so forth that perhaps 15 years ago they would not have been so long-term oriented. So you actually have that happening in the private sector right now.

Ms. BELTZ. Could I just add a point on this point of collaboration?

I want to back up to a comment that was made about "team sport" and who is on whose team. Really, the U.S., Germany, and Japan and other trading partners? Is this issue collaboration?

You have really seen a takeoff in the number of international alliances particularly in the information technology area which is broadly defined.

So I get back to my earlier comment, which again is how the treatment of foreign-owned firms are dealt with through the technology programs.

You cannot define the "who is us" question on the basis of ownership. Frequently you cannot even define it clearly on geography. You have—I can run through a list of these alliances and how they have increased within many of the strategic technology areas like HDTV, like flat panels, like advanced semiconductors and things like that.

So my point goes back to a comment made on the first panel. Things have changed. Global competition has arrived in the United States and firms have globalized their production and R&D strategies.

As this committee and others look at technology programs, you need to think clearly about first of all has the collaborative R&D in the private sector moved to such a point that any of these spillovers or large up-front capital costs are being dealt with through private R&D measures?

Then, second of all, when you get to this issue of how do you treat foreign firms, I think you will find it increasingly difficult to define who is "us."

We have had hearings before on this. This is not a new issue. My only point is it has become much more complicated since the HDTV debate—high definition television.

Mrs. MORELLA [PRESIDING]. I want to now turn to Mr. Brown, but before I do I wanted to tell Mr. Gutknecht how much I appreciated his presiding while I was gone.

Mr. Brown?

Mr. BROWN. Thank you very much, Madam Chairperson.

[The prepared statement of Mr. Brown follows:]

Opening Remarks
George E. Brown, Jr.
Ranking Democratic Member
Committee on Science

Hearing on Department of Commerce Budget Request
March 23, 1994

Madame Chairwoman:

I wish to compliment you and your staff on your efforts to provide a full airing of the issues surrounding the FY 1996 Department of Commerce's budget request for the Technology Administration. You have assembled a knowledgeable slate of witnesses who should increase our knowledge on these matters considerably. It is expecially pleasing to me that we have reached the point where technology, once almost exclusively the domain of men, is now a field of opportunity for women as well. We are led by a chairwoman and have a female majority on this subcommittee, and our witnesses include women who head technology agencies and a major manufacturing center. This is a great change from my student days at UCLA and later as a practicing engineer, and a welcome change as well.

Unfortunately, all is not well in the technology world. We will hear from the head of our oldest national laboratory, which has spent almost a century in service to industry. Despite this proud history, many Congressional critics have lost sight of our traditional government roles in helping U.S. industry compete. We will hear from companies that have been helped tremendously by industry-led partnerships; yet helping industry create the future wealth and the jobs our children will need is being portrayed as misguided corporate welfare. We will hear about very successful efforts to help U.S. manufacturers modernize; yet our own budget committee considers these efforts to be forbidden industrial policy and candidates for extinction.

I confess I have trouble understanding this new political correctness and why efforts to help business -- efforts begun in the Teddy Roosevelt and Ronald Reagan administrations -- are now so wrong. These programs were born in bipartisanship. Our former Republican colleague, Bud Brown, made a major contribution when he came up with the first critical technologies list describing where the U.S. ought to concentrate its resources. Don Ritter, another former Republican colleague, wrote one of the bills which led to the Advanced Technology Program. Sherry Boehlert and our former Republican colleague Claudine Schneider were the House visionaries behind the Manufacturing Extension Program. Bob White, Alan Bromley, Tom Murrin, and other Reagan and Bush Administration officials were leaders in developing and implementing these programs.

I hope that we wake up before it is too late. We are in the competition of our lives with countries around the world that admire our standard of living and how we got there. Our competitors listened to our quality gurus like W. Edwards Deming and Joseph Juran and are beating us at our own game of efficiency and high quality. They patterned manufacturing extension services after our successful agricultural extension service and we now face world-class suppliers around the globe. They followed the advice of American management consultants and set up cooperative research programs that have contributed to years of favorable trade balances with the United States. These countries are not going to back off in their efforts to improve their trade positions and their standards of living just because we do.

Technology development is a risky business. It is always possible to find reasons not to do something. It is always easy to find mistakes to ridicule and generalize. It is easier to do nothing or to pretend that the tax code will solve all our problems than to work in partnership in industry. It is easy to attack programs as corporate welfare while ignoring our nation's corporate well-being. But if we take the easy way out, we will pay the price.

Today we will hear from witnesses who have put their lives and careers on the line to start and to improve businesses. We need to hear what these witnesses have to say even if it is threatening to the current conventional wisdom within the beltway and our cozy capitol. I hope that each of my colleagues will listen, ask questions, and learn all they can from the impressive array of witnesses our chairwoman has invited. Then I hope we all have the courage to act on what we have learned.

Mr. BROWN. I am not sure that I am capable of interrogating all the witnesses to the degree that I would like, but I have been following this issue of the government/industry role in advanced technology for quite some period of time, and I have tried to be pragmatic about it to determine what, if any, was the best course that we could follow.

I do not think there is a perfect answer to that. Government does make bad investments. We have seen that happen over and over again.

The other side is also true. I might ask some of you to detail a few bad private investments like the Edsel or something like that—

[Laughter.]

Mr. BROWN. But the point is, we do not live in a system of perfection, and we need to be constantly seeking to improve it. When I began getting deeply interested in this problem of government/industry relation, we had a problem with what we called "adversarial relations." We were fighting each other all the time.

It seemed to me that there was a realm for cooperation if we could define it properly. I spent the last 10 or 15 years trying to define it properly and was able to, with the help of a lot of other people, get the advanced technology provisions written into the Trade Act of 1988 under Reagan, and he signed it because it appeared to be critical to our ability to compete with other countries.

We were not trying to do something dramatic. We were trying to stay alive. We had lost the steel industry. We were losing the automobile industry. And we felt this in California, and we wanted some solutions to it.

Now I am not prepared to accept a solution that the government should do nothing. One of you commented upon the great success of Apple Computer. Which one of you mentioned Apple? I am sure one of you did in your written testimony, at least.

Mr. HUDGINS. I mentioned Steve Jobs in my testimony.

Mr. BROWN. Steve Jobs got his start with an SBA loan, a government intercession.

I think they succeeded in getting additional government help as they went along. Well, it is still a great success story because Steve Jobs and Steven Vosneack, who is even crazier than Steve Jobs, were geniuses in many ways and they deserve full credit.

Now this does not give us much guidance as to what the proper role should be. What we have tried to do with the Advanced Technology Program is let the private sector define that those boundaries should be as much as possible.

I think it is undoubtedly true that the smaller firms, the more innovative firms are the ones who can get the most benefit out of these kinds of things—although big firms can, too.

I note that Hughes is moving along with their satellite digital television system which is based upon the same type of technology that your high definition television is, and Hughes got their start by doing this under ARPA contracts with the Department of Defense.

They are of course the Defense Department's largest manufacturer of electronic systems. They have gotten a lot of benefits that can be translated now into the civilian systems.

My rambling here is aimed at indicating that I am looking for a compatible way of seeing government and industry cooperate for the benefit of this country. We do it in wartime. We should be able to do it in peacetime when we are threatened with economic superiority by the rest of the world. And that seems to be happening.

May I ask Ms. Beltz and Dr. Hudgins if they can help me by defining something other than no cooperation whatsoever, and defining something—and it is not just basic research? I know even Adam Smith would have approved of basic research being funded by the Federal Government, but is there something beyond this we can do?

Ms. BELTZ. Well, let me address that first.

First of all, we are not talking about "do nothing." I think the point I made earlier was that things have changed. I might differ a little bit from my colleague here, but I do think that SEMATECH did some useful things.

One of the things I think they did that was useful was it really elevated the importance of cooperative R&D both vertically and horizontally.

I do think we could have done it for a lot less; okay? I think there are also some structural problems with the way SEMATECH was set up. But I do think there were some positive things.

But since Semitech, you have really seen collaborative R&D increase dramatically in the private sector, both domestically and internationally.

Mr. BROWN. Right.

Ms. BELTZ. So I would back up to that and say, okay, from the economics of this, within particularly say certain technologies, we think this is a good thing, I am not sure that the need is as great as arguments that we were looking at a couple of years ago. That is one point.

The second point is, I clearly believe that there is a role for government in R&D. As an economist I look at this and I say, well, that would be in the area of basic R&D because you have a clear need for that, and the payoffs are so far off in the future that that is something that private industry is not going to fund.

You have seen a trend away from that. That concerns me a great deal in terms of our future.

The third thing I would say is. If you want to—how can we collaborate maybe in helping you to think about this, as well, is that I would go back to some of the regulatory issues and the tax issues that have already been talked about here earlier.

But if you want to sort of keep—because in theory, you can justify a role for government in terms of generic R&D. But I would say that that is an area where the government role is less clearly defined and we should not be expanding it dramatically.

I mean, each one of the program areas that have been basic R&D have been pushed in the area of more applied, and getting tangible results.

So I would again encourage you, if you want to maintain this middle ground area, to keep it small. That means taking programs like NSF and allowing it to focus on basic R&D.

Mr. BROWN. Well, even in NSF I am sure you recall that it began a process under which it began to encourage collaboration between industry, universities, and the Federal Government, engineering research centers for example were created for the purpose of focusing on applied areas which would lead to generic technology development.

Now, was that right or wrong?

Or was a little bit of it okay, but a lot of it not okay?

That is the kind of distinctions that I am trying to make.

Now your discussion on high definition television—and I am going to get your book, if you have got it—

Ms. BELTZ. You may have this one.

Mr. BROWN. May I have that one?

Ms. BELTZ. Yes.

Mr. BROWN. Because I went through that whole debate over the years, and your position I think is that—and perhaps properly so—that we should not have invested a lot of money in HDTV and we did not. We invested a little bit.

But we did some other things, and they were government things. We prevented the Japanese from getting their system licensed in this country for the specific purpose of giving some breathing room for U.S. industry to go ahead and develop the digital systems that they were working on.

Those were being funded by the Department of Defense.

Ms. BELTZ. With respect to that point right there, the FCC had a mandate to set a standard on terrestrial. There was a difference in terms of the Japanese system on the production stand and the terrestrial standard.

The production standard was what the Japanese were further along on in terms of what they were promoting. And the FCC has a mandate. I do think that in the area of HDTV, the most overlooked important lesson is the critical role the competition played and the competition that the FCC actively encouraged because, if you might recall, even the digital breakthroughs that occurred, we were moving even with our American-based competition towards a hybrid type of system—

Mr. BROWN. Yes.

Ms. BELTZ. Where we are now analogue-based.

It was really almost down to the wire in the last six months prior to that that that was pushed to digital. But that competition is the difference in our standards-setting process here in the United States and has been, historically, versus what was done in other countries.

So again I would emphasize the role of competition that led to our advances that took—

Mr. BROWN. You are correct about that. But was not the competition mandated by the structure of the process that the FTC set up—FCC?

Ms. BELTZ. Well, because we have an FCC that allocates broadcasting rights, there was going to have to be an allocation of that.

Mr. BROWN. Well, I am trying to make the point that competition can work together with cooperation with the government to achieve the national interest here. I hope that I am not being too obscure in this point.

Ms. BELTZ. You are not being obscure. I guess I am disagreeing with your point.

I think that with respect to the positive things I would emphasize about the FCC is the fact that it did have a role that was already mandated, and it did emphasize this competition.

But what was being said about and talked about at the time in terms of regular, if we had had a different administration in place, I do not think we would have gotten some of things that we did, or halted the things that we did.

We would have had a billion dollar R&D program. We would have had some of thee other things, I think happen. What was also very interesting with respect to all of this is another point overlooked in the HDTV debate. Folks that were being heard here in Washington were saying often a very different things in terms of what they thought would be useful and helpful to you as industry that differed very much from what engineers often in the same firms were saying outside of Washington.

There is a dynamic that gets put in place when you say this is what we want to do, and the programs and the plans that you are going to then have brought before you, and that is what happened in HDTV.

You did have an ideological response to that in terms of the Bush Administration. From my perspective, that turned out to be a good thing there, but that break is not there right now.

We have a—let me just make a point here about the process. There are clearly winners and losers both in the private sector and in the public sector as well.

What we are talking about here is a process. Many of the firms represented on this panel here, hopefully they will be winners. I really hope for that. But we are talking about a process here, and you have got to ask, where do you put your faith in terms of both the process of both picking and then responding to failures.

There is a fundamental difference in the structure of the government between the incentives that are inherent, no matter how you can move things around, and that is a question that I think that needs to be looked at is where do you put your faith in choosing once you get—because any time you get beyond the basic R&D stage, you are going to have to select.

Your first round of competition might have many competitors in it, or lots of firms. But then as you go further and further along the process, you are going to have—you are going to be picking technologies, and you are going to be picking firms.

The question it comes back to is where do you put your faith in your ability to pick that.

Mr. BROWN. Thank you very much. I will not belabor any further questions here, but this is a very important debate and it will be continued at other opportunities.

Mrs. MORELLA. You can tell it has been very provocative. I would like to recognize now Ms. Lofgren for any questions she would like to ask.

Ms. LOFGREN. I do have a number, but I do not want to—if the gentleman wants to say something promptly, I do not want to cut him off, but I would like to listen to the witnesses.

Mr. CAISSE. If I could just take maybe 30 seconds to agree with Ms. Beltz that the issue is not one of winners and losers; it is of the process.

When looking at the process, if you step back, as to who should invest, who should make those decisions, if you look at it from the perspective of the investor, the venture capitalist who is obviously a player has his constituency, his backers, the pension funds, and they have very short- term goals and very clear goals which are to make a dollar.

If you look at corporations in the private sector, they also have the same goal. If they are not around for the next short term, they are not around for the long term.

If you look at the government as an investor, somebody to decide, their interests are more aligned with their constituency, which is the taxpayer. The taxpayer is going to be around for a long time. America is going to be around for a long time.

So if you step back from particular issues of HDTV and look at the big picture of who should be best investing, who should be making these decisions, not at a technical level, not at a particular winner/loser level like HDTV, but if you look at it from the general makeup of the investor's goal and charter, the government is exactly the one that should be looking at these long-term investments, not the people who have short-term goals.

Ms. LOFGREN. Thank you.

Now one of the things that—I have only been here actually less than—I could have told you day by day, but the days are running together—it has been I guess about two-and-a-half months—

Mrs. MORELLA. Not quite 100 days.

[Laughter.]

Ms. LOFGREN. Not quite 100 days. That much we know.

One of the things that I heard back home and still hear—I am home every weekend—is sort of the inside the Beltway mentality of people who think they know better, and we really need to understand things from the point of view of people making stuff happen out in the real world beyond the Beltway.

I was fascinated by Ms. Beltz's comment, and I think there is some truth to it, that we are in an international environment, and who is "us," and yet just a couple of days ago I was talking to a Silicon Valley firm that was telling me that they could not acquire flat panels because the market is controlled in Japan. They are vertically integrated as a sort of industrial Japan, and it was not a matter of price; it was a matter of controlling not just that market but other products.

I realize that is a TRP project because of its defense implications, but to think that we are all one big, happy world I certainly do not think is in conformity with what I am hearing from people who are in a new world-wide battle that has to do with trade and competitiveness.

In any case, I am interested, as I evaluate the comments here, in hearing from each briefly, each of the panelists, to what their background is in manufacturing and industry, in running a company.

I would like to know how much is "inside the Beltway" and how much of it is out in the field, if each of you could briefly summarize your experiences.

Mr. CARLSON. I am from Michigan. I went to school at General Motors Institute. I have been involved in manufacturing all my career. I graduated in 1967. I started my first company, Zeicom, in 1968. We employ about 350 in Tulane, Michigan. We make plant floor work stations and ship them around the world.

We started Perceptron in 1981. We do three-dimensional machine vision for manufacturing, a variation of the 2 millimeter program, as a result of Perceptron products throughout the world measuring how much deviation and variation we have in automobile manufacturing.

So my entire career has been in manufacturing.

Ms. LOFGREN. Thanks..

Mr. CAISSE. I am from Silicon Valley. I have been there for 25 or more years involved in leading-edge technologies, one of which is a portion of what is now Internet. We were the first commercial at TIMENET. We were the first commercial of such networks. We brought it to the first customer, the National Library of Medicine, in fact, to spread their data base.

I have been involved in startups and new-venture, new technology ventures ever since, and for the last eight years have been working directly with entrepreneurs to help them bring their visions to fruition.

Ms. LOFGREN. Thanks.

Mr. GIBSON. My academic background is I have degrees from MIT in engineering, economics, and management. My professional experience is, I was an infantry officer in Germany for five years, followed by being a sales and marketing manager for technical products.

Then I was a senior management consultant with McKenzie and Company specializing in strategic issues for companies and operational issues, and worked at an awful lot of companies to both help them capture opportunities and to work themselves out of some fairly serious problems.

Personally, this is a new experience for me, being inside the Beltway. This is the first time I have ever come into this environment. We have never been involved in any lobbying. So—

Ms. LOFGREN. We are newcomers together.

Mr. GIBSON. We are newcomers together.

Ms. CONNER. I am also from Silicon Valley. I do not know if I mentioned this. We are going to change the name of Silicon Valley to Diamond Valley.

[Laughter.]

Ms. CONNER. I have 15 years' experience in marketing and sales, all in new product development, both in large and small companies.

My background, educationally, is I have two engineering degrees and an M.B.A. from Harvard. I have been focusing in the area of bringing new products out. I, for one also, this is my first time on the Hill, as well.

Ms. BELTZ. Well I have not started a company, or I am not currently running a company. I am at the American Enterprise Institute, and I have worked with the private sector in that capacity both as I've done research on a bunch of books now, one of HDTV, one on venture capital, and now one coming out on foreign investments which continues to be an area of great interest.

It is in that role, every time you get a mixed panel like this, it is this tension between asking specific questions and general questions as to trying to sort of get beyond the trees to see the forest. That is the type of questions that I have.

Also, with respect to manufacturing—and we can get into this later—but we should look at also sort of the whole services versus manufacturing, just open up that debate. I'll throw that out right now.

Mr. HUDGINS. Having started with the intention of getting my degree in physics and astronomy, I somehow got into public policy. My doctoral work was on the interrelationship between politics and public policy and economics.

For the last decade or so I have worked especially on government regulations, looking especially at companies and what makes them competitive internationally or not competitive.

By the way, I agree with the gentleman's comment that global competition is not just out there in other countries; it is right here—especially focusing again on regulations in terms of international competitiveness, trade, that sort of issue.

By the way, I also worked for a year or two with the Joint Economic Committee. So I have been on the other side, as well as over here.

Ms. LOFGREN. Thank you.

Mrs. MORELLA. I thank the gentlelady.

I just wanted to point out something, remembering Ms. Conner's testimony and some subsequent comments, that when the ATP program was written by Congress, actually it was specifically designed to permit U.S. subsidiaries of foreign-owned parent companies to receive awards providing that their proposed research projects met the eligibility conditions.

It seems to be unfair, according to Congress at that time, to refuse to fund foreign-owned companies that were carrying out research and manufacturing activities in the United States.

So I just wanted to emphasize that this was Congress' intent; and, in making the awards, they are not trying to circumvent what the intention was.

I just have one little question to ask about.

Do you have any examples of where you think that the ATP awards were not appropriately or fairly granted, or granted not on the basis of merit? I guess I am curios. I guess I would be directing that to Dr. Hudgins, or Ms. Beltz, or Ms. Conner. Maybe Ms. Conner doesn't know.

Ms. CONNER. I do not think I have an example of where it was unfairly awarded. I think in our perspective specifically in the area of diamond technology, there were three awards given on the same industry in the same application area; and that application area is cutting tools.

So both in diamond technology and in cutting tools, the first two were given to—in the process—were given to U.S. based companies. One was to Torcells, and one was to Westinghouse. The third one was given to a French-owned company.

I just thought that it was, you know, not the best use of taxpayer funds in that area since it was already available, and especially in the same industry area. If it had been an industry area, for example, in electronics, or medical, or in a variety of application areas that diamond is useful for, then it really would not have been an issue.

One other issue that does grate on me a little bit is that we have the same program manager. Three programs are managed by the same program manager, and there is a concern—although this certain certainly, I am sure, would not be intentional that any proprietary information would travel among the groups, but if you have the same program manager, you always worry that he or she might disclose something to the other group that might not necessarily—that would be considered proprietary by the company.

So that is a concern, as well.

Ms. BELTZ. I just have a quick comment.

I don't have a problem with the way the awards have been made in terms of the specifics. That's not what my comment is on. My comment is on, why is that unfair to have three awards given in the same application area?

I mean, that is competition, in terms of how you develop a technology. The idea here is sort of to imitate the marketplace in terms of where that technology might be going and competition is a good thing and it encourages competition in R&D.

So I don't understand why that is unfair.

Mr. HUDGINS. I have not seen any examples of what I would call corruption. It seems that the people making the decisions are trying to do it to the best of their knowledge. Most of my objections are that it is a process that should remain in the private sector.

I would warn about one problem in the long term. I have seen this with other government programs that I have looked at, whether it is NASA, or others in Commerce, that in the long term the people in the agencies tend to act like what I call "bureaucratic entrepreneurs."

That is, they know if, given a pool deserving recipients they know to spread the handouts around in a certain way that will be politically advantageous.

The bigger an agency gets, the worse that problem tends to become. When they are small, it tends not to be as big a problem. When it gets large, you find that the bureaucrats themselves know whether something is earmarked or not they had better make sure that this state gets a few, and this state gets a few. So that is something to look at in the long term with the program as it really grows and balloons.

Mrs. MORELLA. I would think Congress would be more apt to do that than the so-called bureaucrats.

Mr. HUDGINS. Both of them do, and that is why we call it the iron triangle, and the recipients are the other part of the triangle.

Mrs. MORELLA. But you should have more faith in our federal employees, that we are now going to cut by 272,900 in a short period.

I really appreciate this panel. I want to recognize Mr. McHale from Pennsylvania who has joined us to see if he has any comments or questions.

Mr. MCHALE. Thank you, Madam Chairman.

I am Congressman Paul McHale from Pennsylvania. Educationally I have visited MIT, and I was twice rejected by Harvard.

[Laughter.]

Mr. McHale. And this is not my first day on the Hill.

[Laughter.]

Mr. McHale. I have been very impressed by the substance of the testimony that has been presented. I apologize that I missed a portion of it. I am a member of the National Security Committee, and simultaneously there were two scheduled meetings of the subcommittees of that committee. So I am at my third stop, and for that reason I did not have the opportunity to hear all, although I heard a good portion of your testimony and I welcome it.

I have one question that is really more philosophical than specific, and I would present it to all of you:

Given the various comments that were made earlier about government targeting and the difficulty, and perhaps counterproductive nature of such targeting, is it appropriate for the United States Government to support hydrogen R&D, the Space Program, the DOE National Labs, and for those of you who may—I see some folks smiling in anticipation of the answer, and I suspect there are some opinions on the subject.

In Pennsylvania we have the Ben Franklin Partnership that goes back to the gubernatorial administration of Republican Richard Thornburg where a public-private partnership in the area of technology was established.

How do you feel about that?

Is that an appropriate role for government?

Or are you unequivocally opposed to that type of public intervention in the private sector?

Ms. Conner. I would like to start, Mr. McHale. I am a little familiar with the Ben Franklin Partnership because one of our competitors benefitted from a collaboration with the government.

I think it is a very important program, particularly for small companies. I might start by saying that prior to becoming an officer of a small company, I did not agree with that philosophy. I did not agree with industrial policy in general, and now I see how important it is to small business to have the capability to obtain funds for high-risk technologies.

I might give you an example of where the ATP, or a collaborative program like NCMS might be useful in something that we just had presented to us.

We were approached by a major automotive firm recently to help them develop a diamond-coated part for one of their—for a car. When we showed them the price tag of what it was going to cost to develop, they said, oh, well, maybe next year.

We decided as a group to participate in the ATP. We are going to be proposing this idea. That would not be possible without this kind of an ATP program.

Now the issue—and so I am not arguing against ATP. The issue though is getting as much decision-making power from the companies themselves and taking away from, not to use the word "bureaucrats," but from government employees.

I think the Franklin Partnership has addressed some of those issues, as well, and has really on a local basis given funding to companies in Pennsylvania that have I think been very successful.

Mr. McHale. I would just insert. For the first ten years that I was involved with that program as a state legislator, it really had no ideological or philosophical overtones. It was proposed by a moderate Republican governor, supported by members of both political parties, and truly it was not until I got down here that I saw for the first time some of those issues being presented from an ideological perspective.

I would invite further comment.

[No response.]

Mr. McHale. Any other members of the panel?

Mr. Carlson. You know, I look at our society and what element of the society has the responsibility for making long-term strategic investments for the good of the Nation.

Speaking as a CEO of a public company, I can tell you one thing; that it is not my job. My shareholders have given me no indication that they are interested in me making long-term strategic investments for the good of the Nation. We are the country of thoroughbred quarter horses, and I am one of them.

[Laughter.]

Mr. Carlson. I hit my numbers every quarter. So if we are looking to the private sector to make decisions in the long-term strategic good of the Nation, I think we are making a serious mistake and I think it is getting worse. We are all getting more short-term oriented as the world gets much more competitive.

The system is not all bad. As long as we figure out where in our team those long-term strategic decisions are going to be made.

Now when you look at the Japanese team, they put the best and the brightest into their government ministries. The top graduates go into the government.

Now it is a team. Everyone knows the top graduates are going to go into the government, and they are going to come out into industry. What is encouraging to me is to see the two leaders that we had here this morning on the first panel. Those two women are outstanding. They are the type of leaders that we need in government ministries that are making the long-term strategic investments for the Nation.

So I would contend, when I look at who is best capable of making these strategic decisions, I think you have some very good leadership right now in the NIST and in the Commerce Department.

Mr. Hudgins. I would not trade America's technological prowess to that of the bureaucrats in Europe, and I would not trade, by the way, our technological and economic situation for Japan's, either, even though I think Japan has been very successful. MITI's record has been mixed, to say the least, and I think it is worth examining.

I will just mention one area, since you brought it up. I have done a lot of work on space policy and looking at NASA in particular.

What I have found was that Apollo and the moon landing was of course more political. We probably would have gone there and stayed if we had done it over a longer period of time. But after Apollo, the record indicates the dangers of having a government agency involved.

The area where the government was least involved, the telecommunications satellite area, is doing very well. Launch costs have been down, and so forth.

In the area that NASA has been most involved with, launch costs and real inflation-adjusted dollars went up since Apollo on the shuttle. When it was discovered that the shuttle was not in fact going to be a cheap economic way of getting things into space, we decided to put up a space station which does not have paying customers on it and looks still to be a boondoggle.

What is worse is that NASA systematically kept out private sector options, where they could have contracted out for example for a small private station; or they could have done what the early developers of civil aviation did where when the government needed something they would simply say, you deliver the product.

Because of that, I think one of the reasons we are not as far in space, we do not have Moon bases today perhaps, is because of the way NASA was run.

I think it is a very instructive example. Because for people like myself who really like Space exploration and things like that, I see NASA as having thwarted some of the dreams of people interested in these things.

So I think it is a good cautionary note in terms of what we are discussing today.

Mr. McHale. Thank you, Madam Chair.

Mrs. Morella. Thank you.

I want to thank the panel. You can see how interested we were in your testimony. I know that there will be questions we would like to ask you for the record.

We would like to ask our third and final panel, if they are still here, to come forward.

Ms. Jan Pounds, the Director of Massachusetts Manufacturing Partnership, Bay State Skills Corporation in Boston; Mr. Leo Reddy, President of NACFAM, Washington; and Mr. Larry Rhoades, president of Extrude Hone Corporation in Irwin, Pennsylvania.

Again, I really do thank you for being so patient. I hope that what you have heard connects and that you have found it interesting, agree/disagree, and will share that with us, too.

We have asked you if you would limit your statement to five minutes, but if you would like to limit it more than that, we would be very appreciative.

Thank you.

Maybe we will start off then with Ms. Pounds.

STATEMENT OF MS. JAN POUNDS, DIRECTOR, MASSACHUSETTS MANUFACTURING PARTNERSHIP, BAY STATE SKILLS CORPORATION, BOSTON, MASSACHUSETTS

Ms. Pounds. Thank you, Madam Chairwoman.

I appreciate the opportunity to come and share my experiences with NIST's Manufacturing Extension Partnership, with the subcommittee today, and certainly will try to keep my comments brief.

The Massachusetts Manufacturing Partnership is one of NIST's MEP affiliates, and just recently started. We provide manufacturers, small manufacturers, with access to resources and information which produce applicable, bottom-line results for them and their companies, and measurable economic impacts for both the manufacturers and for the economy.

During the last three years I have been the director of two MEP centers— one of the original seven in Minnesota, and now the newly formed one in Massachusetts.

I have also worked for both the U.S. and Japanese manufacturing companies. Having learned Japanese lean-production techniques and continuous improvement from the masters of that arena, I cannot state strongly enough that U.S. small manufacturers need to change the way they are doing business in manufacturing if they intend to maintain their existing market share, much less increase that share or enter into new foreign markets.

When most people think of manufacturing they think of the large companies, the AT&Ts, the GEs, the auto manufacturers, and yet there are over 381,000 small manufacturers in the U.S. that employ more than 12 million people.

The majority of those have less than 50, or even 10 employees. In fact, the small manufacturers like Gauthier Medical in Rochester, Minnesota, are the foundation of most of U.S. Commerce.

They do things like supply raw materials and subcomponents to the larger companies.

They support the new and emerging high-tech industries by building the products that other R&D companies conceive and develop; and they certainly support the retail and service and banking industries by supplying products and communications systems for those industries.

In many small towns, the 10 or 20 person manufacturing firm is the largest employer in that town. Often in the urban areas, in one city block there can be anywhere from 15 to 30 small manufacturers.

The sophistication of industries range from the hosiery industry in North Carolina, to the aerospace and electronics Tennessee, to the newly emerging product companies like the Antaeus Group and Medical Waste Technology in Rockville, Maryland, not far from here.

The types of services that they request range from the same— I was going to say run the same gamut. They are anywhere from just information about manufacturing techniques and technologies to actual assistance with plant floor layouts to improve their efficiencies and their outputs, and the enhancement of their product so that they can deliver to the market much more quickly.

Even with the challenges that face the small manufacturer in the past years, their strength has been their flexibility—their flexibility to respond much more quickly than their larger company competitors.

Because of this, they are able to tap niche markets and put products out faster like some of the small companies that custom-manufacture bath and shower fixtures who employ 19 people, and yet are a booming industry in western Pennsylvania.

Today, however, they are losing more and more of that flexibility. One of their biggest challenges right now seems to be meeting payroll on Friday. I was just recently meeting with a Massachusetts plastics company that was going to meet payroll this Friday with his wife's credit card.

Unfortunately, that situation is all too common for the small manufacturer. MMP is going to be assisting the company to streamline their production processes, reduce their scrap, and improve their scheduling so that they can [1] avoid that problem in the future; and [2] pay off the family credit card bill to again gain some of that flexibility.

The small manufacturer's competitors in other countries like Japan and Korea and the European community have increased their productivity, lowered their costs, and are outstripping the capabilities of the small U.S. manufacturer.

Additionally, the large manufacturers are "outsourcing" worldwide some of the components that they put into their products. Whether their customers are large or small, or the government, the small manufacturer today in the U.S. has to learn how to build it better, faster, and cheaper, and cleaner, if we are going to do it in the U.S. And they are going to have to learn how to continuously improve in order to survive.

These small manufacturers are the MMP's customers. As Mr. Tanner referred earlier, many of you have heard from these customers through letters and phone calls, and they are our biggest spokesperson.

In front of me today on this table are over 600 letters that I know of that have been sent to your committee, as well as others, from those small manufacturers and those customers about MEP.

Certainly my colleagues on the panel will tell you more and more about the facts and figures about MEP and the return on investment that it is having. But the one thought I would like to leave you with today is that NIST/MEP is teaching the small companies to build it better, faster, and cheaper, to keep their doors open, and to recapture foreign markets, and to produce a substantial return on investment for the dollars that are being invested in it.

It is needed, wanted, effective, and it works for both the manufacturers and our economy.

[The prepared statement of Ms. Pounds follows.]

The U.S. Department of Commerce
National Institute of Standards and Technology's

MANUFACTURING EXTENSION PARTNERSHIP (MEP)

Testimony by:

Jan Pounds, Director
Massachusetts Manufacturing Partnership
An affiliate of NIST's Manufacturing Extension Partnership

Before the Technology Subcommittee of the Science Committee
U.S. House of Representatives
March 23, 1995

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Chairman Morella, Ladies and Gentlemen,

I would like to thank you for the opportunity to talk with you about the Manufacturing Extension Partnership. The Massachusetts Manufacturing Partnership (MMP) is one of NIST's Manufacturing Extension Partnership affiliates. MMP provides manufacturers with access to information and resources that produce applicable, cost-effective solutions and measurable results for small manufacturers and the economy.

I have been the director of two MEP centers, one of the original seven in Minnesota and currently, the newly established Massachusetts Manufacturing Partnership. I came to MEP from private industry. I have worked for both U.S. and Japanese-owned manufacturing companies where I learned the Japanese lean-production techniques, continuous improvement, and management philosophies from the inside. I have also seen how the governments of Japan, Denmark, Germany and Switzerland are working to support their small manufacturing.

Having seen the competition first hand, I cannot state strongly enough that U.S. small manufacturers will need to **CHANGE** their current manufacturing and business practices. They need to change to maintain their existing market share, much less increase that market share or enter new foreign markets.

When most people think of manufacturing, they think of "large" manufacturers - - AT&T, GE, Motorola, the auto manufacturers, etc. However, there are 381,000 small manufacturers in the U.S. that employ nearly 12 million people. In fact, small manufacturers, like Gauthier Medical, Inc. of Rochester, Minnesota, are the foundation for all U.S. commerce, producing over half of the entire U.S. manufacturing production. MEP serves these small manufacturers who, in turn

- support large manufacturing companies by supplying their raw materials and sub-components;

- support the new and emerging high-tech industries by building the products that they and other R&D companies conceive and develop; and

- support the retail, service, and banking industries by supplying products and communications systems needed and used by those industries.

In many small cities and towns, a 10 or 20 person manufacturing facility is often the largest employer. In larger urban areas, there may be as many as 10-15 small manufacturers in a single city block. The size, location, and sophistication of these manufacturers range from the hosiery manufacturers located in North Carolina, to aerospace electronics in western Tennessee, to newly emerging product companies like Antaeus Group and Medical Waste Tech. Inc. located near here in Rockville, Maryland. The types of services that this diverse group requires and requests ranges from basic information about manufacturing and technologies to assistance with plant layouts in order to improve output, to product enhancement and development, to market research and business planning for production.

In the past, one advantage that small manufacturers have had has been their FLEXIBILITY. Typically, because of their smaller size, they could respond more quickly to changes in markets or customer demands. They could also tap or develop niche markets, such as the Ketcham Company in Allentown, Pennsylvania, has done. Ketcham has 19 employees and custom manufactures bath and shower fixtures for the construction industry.

Today, however, our smaller manufacturers are struggling to keep up. In fact, many of them can not see beyond what seems to be their single greatest challenge - - how to meet their payroll!! I recently visited with a small Massachusetts plastics company that was going to fund their employees payroll checks on Friday by using the owner's wife's personal credit card. To avoid this dilemma in the future, MMP will assist this company in streamlining their production process, reducing their scrap, and improving their scheduling process. With this type of assistance, they will be able to increase production output, meet schedule deadlines, make the sale, and pay off the family credit card bill.

Manufacturers in the European Community, Japan, Korea, China, and many other countries have increased their productivity, lowered their costs, improved their quality, and increased their market shares and are now outstripping the capabilities of the smaller U.S. manufacturer. At the same time, large manufacturers are "outsourcing" more of the components and services required to manufacture their products to small manufacturers worldwide.

Whether their customers are large companies, consumers, local or federal government or other small companies, small manufacturers have intense pressure to produce **BETTER, FASTER, CHEAPER,** and **CLEANER** ! They will also have to **CONTINUOUSLY IMPROVE** in order to survive.

To compound the pressure under which they operate, small manufacturers also lack another very important resource -- TIME. Time to keep up with changes in the industry or markets; time to invest in their workforce, new processes, equipment; time to search for the information needed to solve their production bottlenecks. The result: Many small firms are still using the manufacturing and business techniques with which they started the business and face severe limitations to their surviving over the long run.

These small manufacturers are MEP's customers. Many of you have heard from these customers through their letters and calls. These manufacturers are our biggest spokespeople. The notebooks here on the table contain over 600 letters from them to Congress.

Small manufacturers do not want "corporate welfare." What they do want are the tools to help themselves. They are willing to enter into **PARTNERSHIP** with government, only if they are valued as equal contributors and if the services provided are driven by their needs and delivered by professionals who have manufacturing backgrounds. These companies want a resource that provides unbiased information, cost-effective solutions, access to outside expertise and resources, projects with immediate benefits, and support.

These companies want what the governments of many other countries have been providing for their manufacturers for years. Far too much is at stake for this country to allow the pendulum to swing completely to the other side and consider a return to "**corporate Darwinism.**"

If small manufacturers do not change - - and change soon - - they will be dropped as suppliers or will no longer have markets in which to sell their products. Manufacturing Development, Inc., a 30-person company in Cheney, Kansas, felt the crunch of increasing demands from their customers to incorporate new quality and production standards in their process of manufacturing aerospace sheetmetal components. Company employees did not know which approach to use to find the information that they needed or to determine a cost-effective solution. The MEP in Kansas is currently assisting them to incorporate these new standards.

One of the small manufacturers' greatest enemies is the short-sightedness that results from having to fight the daily battle to survive. If small manufacturers do not change the way that they are doing business, the U.S. will be in danger of losing a large portion of our 381,000 small manufacturing companies and the over 12 million jobs that they provide. In addition to planning for the future we need these small manufacturers now. We need them to produce the products required for the coming era of Information and Advanced Technology.

Both large corporations and several progressive state governments have encouraged and supported change. The federal government needs to stay involved to ensure:

- that **all** small U.S. manufacturers have access to the information, technology, and assistance that is not cost effective for the private sector to provide;
- that efforts stay focused on the nation's overall manufacturing competitiveness, encouraging regional approaches and cooperation rather than a single-state perspective;
- that common performance criteria are applied to the services that are provided in order to ensure evaluation, continuous improvement, and return on investment; and
- that **all** manufacturers have access to the same resources that are available to their competitors in other countries.

The Manufacturing Extension Partnership provides the infrastructure for the U.S., and specifically U.S. manufacturing, to lead the *next* INDUSTRIAL REVOLUTION. MEP will give small manufacturers the tools and information needed to:

- build products BETTER, CHEAPER, FASTER and CLEANER;
- not only keep the doors open to but begin to recapture foreign markets; and
- produce a substantial RETURN ON INVESTMENT for the local, regional, and national economies through their investments in process, product, and workforce development.

My colleagues on the panel have given you the important facts and figures about MEP and manufacturing; the one thought that I would like to leave with you today is: **MEP is NEEDED, WANTED, and WORKS for small manufacturers!**

Manufacturing Extension Matters

Building the National Manufacturing Extension Partnership

A Statement of Common Perspective
by the
Modernization Forum Board of Directors

Jan Pounds, Massachusetts Manufacturing Partnership, Chair
Raymond Christman, Southwestern Pennsylvania Industrial Resource Center, Vice Chair
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Manufacturing Extension Matters:

Building the National Manufacturing Extension Partnership

Manufacturing matters to America. Making what the world wants makes us a prosperous nation. And smaller manufacturers matter particularly. America's 381,000 manufacturing establishments of less than 500 workers employ nearly 12 million people and account for over half of our manufacturing production. Small and midsized firms make most of the parts, components, and tooling required by large manufacturers. They form the broad supplier base of our great metropolitan manufacturing centers and anchor jobs in smaller cities and towns across America.

Today, America's smaller manufacturers are challenged as never before. To perform in the emerging global marketplace, they must master modern technologies, management techniques, and methods of work organization. Our economy will be stronger if thousands of small and midsized firms accelerate modernization of their design, production, and marketing capabilities and the management methods that focus them.

The leaders of small and midsized manufacturers must drive modernization of America's industrial base. As they commit their companies to continuous modernization they would benefit from the support of resourceful organizations dedicated to their success. Unfortunately, most private for-profit consulting organizations have not been able to earn a competitive return serving small- and midsized manufacturers because of the high cost of sales required to reach many firms with modest resources.

Now, a growing number of smaller manufacturers can draw assistance from the Manufacturing Extension Partnership (MEP), the nationwide network of regional and local centers organized by the National Institute of Standards and Technology (NIST) and its state and private sector partners. Begun under President Reagan, enhanced under President Bush, and expanded under President Clinton, the NIST MEP has received growing support from Congress since 1989. $90 million is appropriated for the NIST MEP in FY95. Today, 44 MEP centers and eight related pilot programs have been established in 40 states.

This federal investment is already earning a good return and developing markets. It leverages large matching investments by states. Most importantly, manufacturing firms that use MEP centers now report hard benefits of almost $7 for every federal dollar the centers receive. Centers often use private consultants in their projects with firms and the firms assisted by MEP centers are *more* inclined to use private consultants in the future.

Like the firms we serve, the partners in the NIST MEP strive for continuous improvement. As the leaders of MEP centers, we listen to our customers and to our state and federal investors. In the spirit of continuous improvement, we welcome hard evaluation from them and offer the following responses to eleven questions that have already been posed.

Some Questions & Responses on Manufacturing Extension

1. Why are Small- and Medium-Sized Manufacturers Particularly Important? Small- and medium-sized manufacturing enterprises are the foundation of American industry and do more and more of America's manufacturing.

Small- and medium-sized manufacturers are the broad supplier base for U.S. manufacturing, producing parts, components and tooling for large manufacturers whose products are sold worldwide. The 381,000 small- and medium-sized manufacturing establishments nationwide (98.7 percent of the manufacturing establishments) employ a total of 11.8 million people (64.9 percent of the manufacturing work force) and account for a combined annual payroll of more than $322 billion (57.2 percent of the manufacturing payroll). Small- and medium-sized manufacturing establishments are responsible for the manufacturing sector's only job growth in recent decades. Manufacturing employment declined by 2.04 million from 1967 to 1992 at larger plants of 500 or more workers. During the same quarter century (1967-92), employment at small- and medium-sized manufacturing plants with fewer than 500 employees grew by 1.71 million. (Date from the U.S. Census Bureau's *County Business Patterns 1992: United States* and *Census of Manufacturers, 1967*.)

2. Why Is Manufacturing Extension Necessary? Small- and medium-sized manufacturers often excel in a specific manufacturing process, but many lack the internal staff to master all the dangers and opportunities of performing in the globally competed marketplace. Smaller firms have more difficulty than larger firms in identifying and carrying out high-priority improvement projects. They lack the in-house expertise, time, technical information and funds required to change their operations for the better, according to the National Research Council (*Learning to Change*, 1993).

Many smaller manufacturers have little or no experience working with outside consultants and cannot find appropriate technical experts to provide high-quality, unbiased assistance. Many consultants and consulting firms choose to work with larger manufacturers and ignore the small-firm market because of the high cost of sales involved in identifying clients and providing services to smaller manufacturers, especially those with fewer than 100 employees, the medium size of MEP center customers.

The productivity growth of smaller manufacturers lags behind larger firms. Larger manufacturers improved their productivity (value added per hour worked in manufacturing) at an annual average rate of 2.9 percent from 1967 to 1987, the most recent year for which data are available. Small- and medium-sized manufacturing establishments' productivity grew at an annual average of only 1.3 percent during the same years. Small manufacturers are only 69 percent as productive as larger ones, according to the most recent data, down from 79 percent in 1967. (Data from the Census Bureau's 1967 and 1987 *Census of Manufacturers*.)

Market forces alone have not provided smaller manufacturers with all the resources they need to modernize, raise productivity, and make a stronger contribution to living standards and national economic competitiveness. A national network of centers with some public support to extend services to very large numbers small- and medium-sized manufacturers can overcome the cost of sales barrier and enable market forces to drive modernization of the industrial base.

3. What Is the NIST Manufacturing Extension Partnership (MEP)? The NIST MEP is a nationwide network of organizations that provide comprehensive, hands-on, technical support to modernizing small-and medium-sized manufacturers as they upgrade their equipment, improve their production processes, and strengthen their business performance.

The NIST MEP program awards limited federal funding *on a competitive basis* to non-profit manufacturing extension centers that serve firms in specific states and local areas. Each manufacturing extension center tailors its services to meet local needs. The centers provide technical expertise and hands-on assistance for projects relating to appropriate technology, quality assurance, business information systems, production process improvement, plant layout, market development, computer-aided design, computer integrated manufacturing, waste reduction, material engineering, workforce development, rapid prototyping, and other priority manufacturing issues.

NIST cooperates with state governments to set up MEP centers. In many cases, the MEP program builds upon, expands, and enhances state-level manufacturing extension programs, including some that have been serving smaller firms for decades. But each center is a private, non-profit organization and not a part of the federal or state government.

The NIST MEP centers are market driven - - almost all of them charge affordable fees to customer for technical assistance projects. The centers provide assistance broadly to the smaller firms in the manufacturing base of their states and communities. They do not and could not pick winners and losers.

The NIST MEP will soon include 44 affiliated centers located in 32 states and related programs in eight more states. A 1995 competition will add several new centers. A number of these centers are strongly established enterprises; many more are relatively new. The distribution of NIST MEP centers establishes federally supported manufacturing extension in many of America's most industrial states. The 32 states with MEP centers account for 82 percent of all U.S. manufacturing shipments, 81 percent of all U.S. manufacturing employment, and 79 percent of all U.S. manufacturing establishments.

4. Is Manufacturing Extension Working? In a word: Yes. NIST MEP places high priority on evaluating the impacts of its manufacturing extension centers. Based on early evaluations, the MEP is working very well.

During the program year ending in June 1994, the seven centers founded between 1989 and 1992 carried out some 12,350 services for over 10,000 small-and medium-sized manufacturers, including 2,885 technical assistance projects and formal assessments. The manufacturing firms that provided evaluation data said that they expected each individual technical assistance project, *on average*, to result in:

- $19,473 in increased sales;
- $17,518 in reduced inventory;
- $23,776 in savings from labor and material costs; and
- five jobs created or preserved.

Fifteen months of evaluation data from the seven oldest centers and three months of data from five newer centers show that manufacturing firms are reporting total economic returns of almost $7 for every federal dollar that centers receive. The economic benefits behind this seven-to-one ratio were calculated conservatively based on what the manufacturers said they expected in labor and materials savings, their reported savings from unnecessary capital purchases that they otherwise would have made, 60 percent of their change in sales, and 10 percent of the value of expected inventory reductions.

In 1994, Dun & Bradstreet Information Services surveyed 750 small-and medium-sized manufacturers that had been customers of MEP centers and 750 small-and medium-sized manufacturers that were not MEP center customers. A study based on this survey found that small-and medium-sized manufacturers served by MEP centers are up to *six times more likely* to organize specific improvement actions than small-and medium-sized manufacturers of similar size, type of operation, and unit volumes not assisted by a center. The planned actions included applying statistical quality control methods, using computer based information systems, expanding the technical training of workers, and implementing just-in-time delivery procedures.

5. Who delivers MEP Services to Customer Companies? A substantial majority of the directors, managers, and service-delivery field engineers at MEP centers are seasoned professionals with extensive backgrounds in private, for-profit manufacturing enterprises - - including small-and medium-sized manufacturers. MEP centers also make extensive use of the private, for-profit consultants.

6. Do MEP Centers Compete with Private Consultants Who Might Do a Better Job? Neither companies nor consultants themselves believe that MEP centers compete with private consultants. In fact, they complement private consultant services and enhance the potential small manufacturer market for consultants.

The recent study based on the Dun & Bradstreet Information Services survey confirms that more than 70 percent of the small-and medium-sized manufacturers assisted by MEP centers believe that the centers provide services that either complement the work of private consultants or are otherwise unavailable to the firms. The small-and medium-sized manufacturer customers of MEP centers value their services highly: 72 percent considered the center the only or better source of informal assistance or trouble-shooting at little or no cost; 64 percent considered the center the better or only source to perform cost-effective assessments of operations; 65 percent considered the center the only or better source for unbiased information on all relevant products and services for improvement.

MEP centers often retain private consultants for the project teams that serve customers. Consultants typically lower their rates for such work because they do not incur marketing or sales costs. Small-and medium-sized manufacturers are often reluctant to use private consultants, considering them difficult to find, screen, hire, control, and afford. But 40 percent of the small-and medium-sized customers of MEP centers indicated that working with the center made them more likely to use a private consultant. Nearly three out of the four consultants that have worked with MEP centers indicate that the centers' services are beneficial to their businesses.

7. Why Should the *Federal* Government Help Fund the MEP Centers? Strong ongoing federal support for the Manufacturing Extension Partnership is needed to build and maintain the scale, scope, quality, coherence, responsiveness, and strong small- and medium-sized firm focus of the national network. Strong federal support for the MEP will make it possible to:

> Overcome the cost-of-sales barrier to serving very large numbers of modernizing small- and medium-sized manufacturers -- private for-profit providers have not prospered serving small firms because the typical contract is too small to justify the expense incurred in finding and winning the customer;
>
> Reach and assist scores of thousands of small- and medium-sized manufacturers whose improved performance can reverse and close the widening productivity gap between large and small manufacturers, strengthen U.S.-based supplier chains, save jobs, and improve incomes;
>
> Assure that all manufacturing regions of the country have an industrial base of modern small- and medium-sized manufacturers that can defend markets against foreign competition and whose combined capabilities can help anchor the major manufacturers they now have;
>
> Encourage states to invest in improved small- and medium-sized manufacturer performance (a national benefit) rather than intra-U.S. industrial recruitment (at best only a state benefit and often a net national cost);
>
> Reach large numbers of worthy, very small manufacturers whose aggregate contribution to wealth creation and employment is significant but which require more effort to save than large firms, and are often less able to pay the fully burdened cost of service;
>
> Reach tens of thousands of smart firms in small towns that are often the keystone of the local economy but require more effort to serve than comparable firms in dense industrial metropolises;
>
> Link centers together for consortial learning, benchmarking, timely adoption of best practices and tools through robust cooperation among all centers in the national network;
>
> Deploy to scores of thousands of small- and medium- sized manufacturers the technical standards that are the essential enablers of modern manufacturing -- including the standards, technologies, and knowledge that small- and medium-sized manufacturers need to link into the national information highway;
>
> Develop national and international standards through processes that included the voice of small- and medium-sized manufacturers in the United States;

Respond to unpredictable national security needs that require an agile defense supplier base of small- and medium-sized manufacturers to which national imperatives can be quickly communicated and from which timely performance can be expected; and,

Improve small- and medium-sized manufacturers' access to federally funded technology through leveraging national resources such as the federal labs that can make a strong contribution to the modernization of thousands of small manufacturers.

Realization of each of these 11 worthy objectives requires an ongoing federal presence in the partnership. Indeed, the *partnership* is problematic without federal participation.

8. Are Changes in Federal Tax Policy an *Alternative* to the MEP? Wise fiscal policy can be a welcome complement to a nationwide network of manufacturing extension centers but *not* a substitute for the hands-on assistance provided by MEP centers.

Adjustments in the tax code that create incentives for small- and medium-sized manufacturers may eventually pay for the federal tax expenditure incurred, especially if the strongest benefits are targeted to small manufacturers where slow adoption of modern technology and lagging productivity have hurt national economic performance. The MEP community thoroughly respects the tax policy proposals in *Getting Back to Work*, the recent report of the bipartisan Northeast-Midwest Coalition's Manufacturing Task Force co-chaired by Reps Franks and Meehan.

It is wrong, however, to force manufacturers to **choose** between tax breaks and the MEP center services so highly valued by thousands of firms that the MEP network has assisted to date. Well-targeted tax incentives can quicken the pace of technology adoption by small- and medium-sized manufacturers. The benefits of this rapid modernization will be increased for firms, communities, industries, and the nation if thousands of firms get good advice from the field engineers of MEP centers. Tax incentives encourage firms to invest in plant and equipment. MEP centers help modernizing firms to make a wise choice.

9. Why Not Reduce the Budget Deficit by Cutting the MEP? A successful MEP will help reduce the deficit through economic growth. Prospering small- and medium-sized manufacturers will generate taxable incomes and reduce social safety net outlays. Increasing small- and medium-sized manufacturing establishments' productivity growth by only a modest amount will generate very substantial federal revenue.

There are far better opportunities for deficit reduction than the modest appropriations for the MEP. In FY95, the MEP represented only one tenth of one percent of the federal R&D budget, which is still largely dedicated to the missions of the Cold War era. Unlike most R&D spending, the economic impact of assisting the modernization of thousands of small- and medium-sized manufacturers through investment in the MEP is direct and immediate.

10. How Long Should Federal Funds Support Individual MEP Centers? Federal funds should only help support centers that pass aggressive performance reviews with distinction. The MEP should *never* guarantee permanent federal backing to individual centers.

The trial program that has become the MEP was authorized by the 1988 Trade Act. The primary objective was to transfer new technologies from federal labs directly to small- and medium-sized manufacturers through demonstrations and pilot projects -- a difficult experiment in which each center was properly limited to six years of federal support. Through years of experience in the marketplace serving firms in many different industries in all regions of the country the MEP partners have learned that the more important national mission is continuous deployment of current best practice technologies and methods to many thousands of small- and medium-sized manufacturers. *This* mission evolves as progress redefines best practice. This mission *is* worthy of ongoing federal investment.

Yet nothing would damage the market credibility of MEP centers more than for the national network to devolve toward a stable bureaucracy of entitled fundees. Small- and medium-sized manufacturers would shun the services of such centers. The MEP national network must be as dynamic as the manufacturers it serves. The best means to assure this is to compel centers, by rule or culture, to charge fees for most of their services. Maturing MEP centers are already required to raise a growing proportion of their revenues from non-federal (state and private) sources. If the current authorization in the 1988 Trade Act were amended to allow for federal support beyond the sixth year the amendment should require an aggressive review and competition for funds every two or three years.

The centers that continue to pass muster should continue to receive federal funds so that the national partnership maintains its mission of supporting modernization by small- and medium-sized manufacturers. The cost of sales required to reach very large numbers of small firms remains a barrier that centers can best overcome through public support.

The federal dollars that would fund MEP centers beyond their sixth years could allow those centers to continue to concentrate on smaller firms. Without government support, some centers will survive, but only by moving away from the critical small firm market to seek much larger customers that are less expensive to reach and serve and that can pay fees that reflect the fully burdened cost of the service. The final result might be a few more private for-profit consulting firms competing in a crowded market for the fees of Fortune 1000 manufacturing corporations -- an end far different than the sustained modernization of America's industrial base.

11. Is the MEP a *Government Industrial Policy* Picking Winners and Losers? Not remotely. The NIST MEP program does not pick winners from among technologies, industries, or firms.

MEP centers respond to a broad range of current needs defined by a wide variety of small- and medium-sized manufacturers in a given region. Centers do not bet on the future significance of any still-emerging technology. MEP centers support broad and timely adoption of those technologies and practices that the **marketplace** defines as enablers of competitiveness for specific sectors (e.g. computer-aided design and computer-aided manufacturing in tooling) or major industries (e.g. electronic data interchange in auto) or for all of manufacturing (e.g. Total Quality Management).

MEP centers can only achieve impact through sustained service to a large proportion of the small- and medium-sized manufacturers in their region -- not through focusing their resources on any small segment of manufacturers. Some centers do focus on large and very important industry concentrations in the areas they serve (e.g. aerospace in Los Angeles, auto in Michigan), while also responding at some level to the needs of all firms that seek assistance. MEP centers work with a broad range of customers, offering objective strategic dialogue to leading firms, providing average firms with engineering expertise they do not have on staff, and helping firms in stress define priority problems.

The Manufacturing Extension Partnership is sensible support for America's Main Street manufacturers, not industrial policy.

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BIOGRAPHY

JAN POUNDS

Jan Pounds is director of the Massachusetts Manufacturing Partnership (MMP). Established in April 1994, the Partnership was formed as a cooperative agreement between the Commonwealth of Massachusetts and the U.S. Department of Commerce's National Institute of Standards and Technology (NIST). The Partnership is coordinated through Bay State Skills Corporation and provides manufacturing services through five regional offices.

As director of MMP, Pounds is responsible for managing and directing the Partnership's activities, developing programs in response to industry needs with the five regional office directors and evaluating the Partnership's impact on industry.

Pounds received an MBA from the University of St. Thomas in St. Paul, MN. She previously served as the Executive Director of the Upper Midwest Manufacturing Technology Center (UMMTC) headquartered in Minneapolis, Minnesota. She also serves as chair of the Modernization Forum Board of Directors. Her previous experience also includes manufacturing operations management, customer relations and employee training for companies in Minnesota, Kentucky, Texas, and Colorado.

Prior to joining the UMMTC, Pounds worked for Toyota Motor Manufacturing, USA, Inc. Among the first employees hired to work at the U.S. plant, Pounds worked at the company four years, from start-up construction through full two-shift production.

She is a member of the American Society for Quality Control and the Institute of Industrial Engineers.

Mrs. MORELLA. Thank you, very much. I appreciate your comments and your being here.

I am going to leave to go to the Floor. Ms. Cubin will take over presiding, but I wanted to in particular thank Mr. Rhoades. I heard you came in from a vacation in Key West to be with us. Please know that we will relish and cherish every word of your testimony.

[Laughter.]

Mrs. MORELLA. Thank you, very much.

I know Mr. Reddy did not have too far to come, unless he got involved with traffic, living here in Washington, but I want to thank you. You think the MEP is good, too.

Ms. Cubin, thank you.

Mrs. CUBIN [PRESIDING]. It is nice for me to be in this chair. I too thank you for being here. I thank the other panel members that I had the opportunity to hear.

Mr. Reddy, are you ready?

[Laughter.]

STATEMENT OF MR. LEO REDDY, PRESIDENT, NCFAM, WASHINGTON, D.C.

Mr. REDDY. Thank you very much, Madam chairwoman.

I am here today on behalf of the National Coalition for Advanced Manufacturing. We are a coalition of about 300 organizations around the country that are working in and around the factory floor to accelerate the deployment of advanced manufacturing technologies into all tiers of our industrial base.

So we are quite familiar in a very hands-on way with the challenge of what is needed to bring our industrial base into the third wave, or into the information age.

This is not a theoretical concept for it; it is a very real-world challenge. I can tell you from that perspective that to really, truly bring all tiers of our industrial base into the third wave is the industrial equivalent of putting a man on the moon.

It is going to require a national effort to do this. Very definitely we are going to have to combine federal resources with private sector resources, with academic resources to make this happen.

I think that the issue before your committee, and a terribly important issue, is what you can do with the some $70 billion R&D budget to try to facilitate that process, if this indeed is becoming a new national priority, which we think it should.

From our perspective, we think that neither the private sector nor government alone can achieve this major objective. We really have to pool our resources, as Mr. Brown said, in much the way we did in winning the Cold War. We have to learn to pool our resources in a non-ideological and a pragmatic way.

I think that the programs we are talking about, the public/private partnership programs, are exactly the kind of program we need for the future. These are forward-looking, 21st Century type of programs.

They are the only way we are going to be able to achieve this goal. They are programs that are precisely not industrial policy because they are designed to be bottoms-up programs. They depend upon the private sector to develop the programs, to manage the programs, and the fact that they are bottoms up, it seems to me, is the very antithesis of industrial policy. It prevents industrial policy.

This is why we support ATP and MEP both. Let me say very briefly on MEP, as people working in and around the factory floor on these issues, that structurally probably the greatest impediment we have to actually bringing our industrial base forward and modernizing it are the structural weaknesses which face our small and medium sized companies. There are two major short comings in the market for these companies.

First of all, as a business proposition most vendors who are bringing the latest technologies to bear simply find it uneconomical to sell, to market to the smaller companies. The return on investment is just not great enough.

Consultants have the same problem. It is simply not a good business for them to try to reach out to these smaller companies.

Some intervention is necessary to provide the necessary technical assistance for these companies to adopt the new technologies they need to be competitive and to serve the needs of our larger firms to produce high quality, highly competitive products.

The only device that we have been able to find that effectively fills that gap are extension agents who actually go into these two companies and in a cost-effective manner introduce them to the latest technologies and related processes.

Some government intervention in the process is necessary. It will probably be necessary for a long time to provide for that infrastructure of support to take place and to flourish.

The federal role in stimulating that process is absolutely indispensable. We would not be looking at 35 States today, even at the very limited federal funding we are talking about, having extension services, if it were not for the seed capital and for the leadership provided by the Federal Government to make that happen. It would simply not have happened and will not happen without some investment from the Federal Government.

I was just at an MEP in Toledo just last week. The industrial committee there was exhilarated over the fact they were getting that program.

What is hard to perceive when you are inside the Beltway is that outside the Beltway each one of these federal dollars is a powerful stimulant to other investment, to matching funds.

It brings prestige also to those communities to be recognized in a competitive process. These are excellent programs. These kinds of partnership programs, particularly MEP, are exactly what we should be doing with our R&D budget.

I would agree with Arati Prabhakar that these are the last programs we should be cutting. And Congress, rather than cutting these programs, should be joining with industry. I think you have seen the strength and support from industry today at this hearing. And I think you have seen it in the 600 letters presented today by Ms. Pounds. Congress should get with it.

Congress should join industry in trying to modernize our industrial base so we will be the most competitive industrial base well into the 21st Century.

Thank you.

[The prepared statement of Mr. Reddy follows.]

NACFAM
The National Coalition
for Advanced Manufacturing

"An Industry Perspective on Private-Public Technology Partnership Programs: Manufacturing Extension Partnership (MEP) and Advanced Technology Program (ATP)"

TESTIMONY BY LEO REDDY

President, National Coalition for Advanced Manufacturing (NACFAM)

Before the Technology Subcommittee of the Science Committee,
U.S. House of Representatives, March 23, 1995

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Testimony by Leo Reddy, President of NACFAM
Technology Subcommittee, House Science Committee
March 23, 1995

SUMMARY

As an industry-led organization whose members are working daily to accelerate the deployment of information-based technologies into the nation's industrial base, NACFAM believes that a national effort is required for U.S. industry to move from the "Second Wave" industrial economy to the "Third Wave" knowledge-based economy.
Since neither industry nor government can lead this effort alone, partnerships have become vital in the private sector and are increasingly important in the government sector.

NACFAM thus supports private-public technology partnerships based upon industry initiative and cost-sharing. Two successful examples are the Manufacturing Extension Partnership (MEP) and Advanced Technology Program (ATP).

MEP provides critical information needed by the nation's small and medium-sized manufacturers in achieving globally competitive levels of productivity, quality, cost reduction, and time to market. Extension agents offer cost-effective assistance, especially in quality control and inspection, systems management, market development, resource planning, and computer-aided design, manufacturing, and engineering.

Performance data show that MEP client companies report benefits of more than $8 for every federal dollar and significant gains on average per project, including 5 and a half jobs added or saved. Federal seed capital is a strong stimulus for state and private sector investment in extension. A federal program also offers ready access to information sharing and coordination among the states, to best practices and standards, and to federal lab technology.

ATP helps to resolve one of the major structural failures in the nation's overall science and technology enterprise: the gap between basic research and product development. ATP addresses this issue by lowering the risk of technology experimentation and by involving industry directly at each stage of the process.

From the industry perspective, the most attractive feature of ATP is precisely that it is not industrial policy. Rather than being a top-down program rooted in government decisions, it is based upon proposals conceived and managed by industry. Indeed, the direct involvement of industry and industry co-funding are the best safeguards against industrial policy.

MEP and ATP are the kinds of federal technology investment that best fit the competitiveness needs of U.S. industry and offer the highest return for the American taxpayer and the U.S. economy. Congress should join industry, not in reducing these partnership programs, but in nurturing their success and growth.

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Introductory Remarks

Chairwoman Morella, Ladies and Gentlemen,

On behalf of the National Coalition for Advanced Manufacturing, I would like to congratulate you on your new position as Chair of this important Subcommittee. This body's deliberations in the years ahead will have a lasting effect on America's ability to preserve a strong lead in the global technology race.

House Speaker Gingrich has spoken eloquently of the urgent need for this nation to migrate from the "Second Wave" industrial economy to the "Third Wave" knowledge-based economy.

NACFAM is a quintessential "Third Wave" organization. The members of our industry-led coalition are working daily in and around America's factories to accelerate the adoption of information-based, computer-integrated manufacturing technologies by all tiers of the U.S. domestic industrial base, including small- and medium-sized firms. Industry requires these technologies to compete in today's global marketplace, where pressures for flexibility, quality, cost reduction, and speed to market are unrelenting.

Nearly 300 organizations participate in NACFAM programs and services to the industrial base: companies of all sizes, non-profit technology centers, national trade associations, and national technical education associations. These organizations represent tens of thousands of firms and technical workforce training institutions.

Since a broad national effort is needed to transform our domestic industrial base, the federal government will inevitably play a major role in this historic process. Whatever the outcome of budget deficit reduction and government downsizing, federal policies in the fields of taxation, monetary policy, education and training, acquisition, national security, transportation, regulation, telecommunications, export promotion, and trade negotiations will continue to have far-reaching effects on industrial modernization and competitiveness. The federal government also funds about 70% of all basic science and 40% of all R&D in our country.

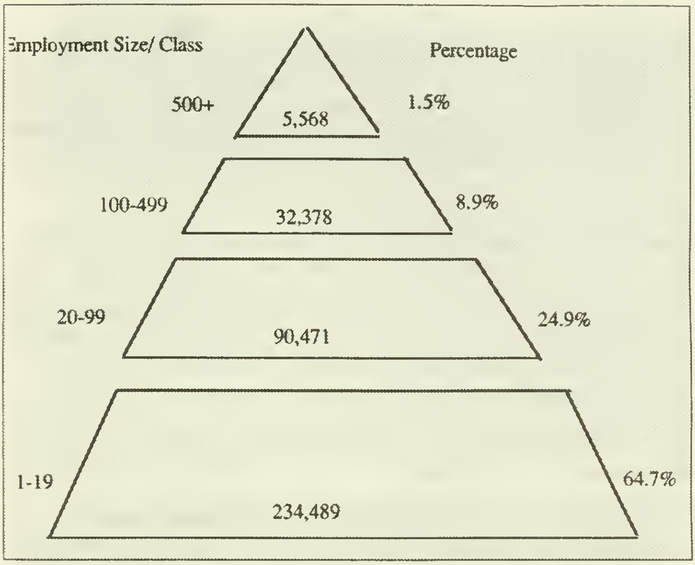
Among these various issues, NACFAM is most interested in those that relate directly to the factory floor: technical assistance to smaller suppliers of manufactured parts and components, the development of new manufacturing process technologies, technical workforce training, and capital availability for factory modernization.

Madam Chairwoman, you invited me to comment today on two federal programs that play a role in both the deployment and development of manufacturing technologies: the Manufacturing Extension Partnerships (MEP) program and the Advanced Technology Program (ATP) administered through the National Institute of Standards and Technology (NIST) under the U.S. Department of Commerce.

Manufacturing Extension Partnership (MEP)

Since its founding in 1989 as a post-Cold War industrial modernization organization, NACFAM has stressed the need to accelerate the deployment of information-age technologies to small- and medium-sized manufacturers. NACFAM's "Pyramid Chart" (Figure 1) illustrates the importance to America's industrial base of small and medium-sized manufacturing establishments with fewer than 500 employees.

Figure 1. U.S. Manufacturing Establishments
(Source: U.S. Bureau of Census, December 1990)



These establishments employ 65% of the manufacturing workforce--12 million mostly high wage, high skills jobs. They contribute to growth in manufacturing employment, as employment in larger firms continues to decline.

While dramatic, this quantitative picture does not portray the qualitative changes that are going on between large manufacturing firms and their suppliers. Due to the greater efficiencies of outsourcing, large companies today rely increasingly on their suppliers to make the parts and components for their products . Since multinational firms have the option to procure those parts anywhere in the world, the future of our own domestic industrial base will depend heavily upon the ability of U.S. suppliers to achieve globally competitive levels of quality, productivity and price.

Those suppliers must compete against cheap overseas labor, cut-throat pricing, and companies that receive extensive technical assistance, tax breaks, and subsidization from their own governments. To win--without reducing wages to American workers--U.S.-based small and medium-sized suppliers must have access to advanced productivity-enhancing manufacturing technologies, to a highly skilled technical workforce, to capital for factory modernization investment, and to technology management skills.

Given the rapid pace of technological change, however, especially the burgeoning demands from large firms for rigorous quality standards and electronic data interchange, smaller firms are hard pressed to acquire the new technologies and methods they so badly need. Although these firms are improving their performance, the productivity gap between large and small firms continues to grow. Many smaller manufacturers lack the in-house capacity, engineering staffs, and time to keep up.

Manufacturing extension services can play a major role in meeting their needs. Experienced extension agents assist small- to medium-sized firms in finding cost effective solutions to the full spectrum of their competitiveness challenges. Because they deal with hundreds of firms, extension agents offer front-end needs assessments, help benchmark the firm against its global competitors, and pinpoint major problem areas. Extension agents play an especially important role in quality control and inspection, systems integration, market development, resource planning, and computer-aided design, manufacturing, and engineering systems.

Once having isolated the problems, these agents can tap into an enormous body of resident expertise: private consultants, tool providers, state agencies, training institutions, federal and university research centers, financial institutions, standards bodies, etc.

This model is not new to the United States. The Agricultural Extension Service, a cooperative program between states, localities, and the U.S. Department of Agriculture, has functioned with remarkable success for over 85 years. The technologies and information that agricultural extension agents have brought to America's farms explains why our agricultural sector is the envy of the world and a major source of U.S. exports.

Another reason for the success of that program is that it operated on a truly national scale, with 3,140 field offices and a billion dollar cost-shared budget, with the federal government contributing over $400 million.

By these measures, technical extension services for smaller manufacturers is diminutive by comparison--even though agriculture represents less than 3 percent and manufacturing more than 20 percent of gross domestic product . FY 92 federal funding for manufacturing extension was under $17 million per year and supported only seven centers. Even with its subsequent expansion, MEP is still co-funding only 44 centers--a small fraction of those needed to provide effective assistance to some 380,000 manufacturing establishments with fewer than 500 workers.

Before contemplating any further expansion of MEP, however, the new Congress needs to ask whether the taxpayer is receiving a sufficiently high return on investment. We often ask ourselves the same question in NACFAM from the point of view of the industry "customer" for this program.

Performance measurement for industrial extension services is a difficult and inexact science. In its administration of MEP, however, NIST has been assiduous in demanding that federally-supported extension services collect data continuously on their effectiveness. Indeed, in this regard MEP may be one of the most rigorous federal technology programs in its effort to demonstrate return on the taxpayer's investment.

The evidence collected by NIST thus far on the impact of the MEP program suggests that these services offer an exceptionally high rate of return (see Figure 2):

Figure 2.

- To date, the MEP program has reached more than 25,000 small manufacturers
- Client companies have reported benefits of more than $8 for every federal dollar centers have received
- Clients who report benefits from MEP service, on an average per project basis, report 5 and half jobs added or saved, $43,000 savings in labor and material costs, and in increase of over $369,000 in sales
- Client companies are up to six times more likely to plan technical improvements than similar unserved companies

Another view of the effectiveness of manufacturing extension centers is offered by a 1993 KPMG Peat Marwick survey of the eight Industrial Resource Centers (IRCs) in Pennsylvania. According to this survey, 92% of the respondents characterized their experience with these IRCs as good or excellent. They reported that IRC services have increased revenues, reduced costs, heightened productivity, and added jobs.

It is fair to ask why these services, if they add so much value, can not support themselves in the market or with state funds. Most of these services do ask and receive fees from their industry clients, and 35 states are now contributing to industrial extension services.

Without federal support, however, this network of extension centers will be unlikely to reach a sufficient number of clients to have a macroeconomic impact on the nation's industrial competitiveness. Federal involvement will help assure that all manufacturing regions have competitive industrial bases and that there is some level of coordination and information sharing among divergent state programs. A federal program also offers ready access to global best practices, to national and international standards, and to federal lab technologies. Most importantly, federal seed capital is a strong stimulant to state and private sector investment.

In addition to improving capabilities of extension services, the federal role significantly improves their outreach. I discussed this issue last week during a visit with an MEP center director in Toledo, Ohio, a major manufacturing center. He commented that the federal role in indispensable to his center in being able to cross state lines to assist companies important to his region--which he could not do if he were solely dependent upon state funds.

Would private consultants fill the needs of smaller manufacturers in the absence of government-supported extension services? According to a 1994 Dun & Bradstreet survey commissioned by the Modernization Forum, more than 70% of the manufacturers who have received assistance from manufacturing extension centers (MECs) indicated that MECs provide services that either complement the work of private consultants or are otherwise unavailable to these manufacturers. Most of the companies surveyed report that MECs are either the only available source or are considered a better source of informal assistance, unbiased information, and cost-effective assessment of operations.

If left entirely to their own resources, manufacturing extension services would need to turn to larger firms for fees similar to those asked by consulting firms. This would leave smaller companies without the technical assistance they will need to survive global competition.

Advanced Technology Program

The continuous development of state-of-the-art manufacturing processes is another key to moving U.S. industry into the Information Age. According to a December 1994 report, Technology, Economic Growth and Employment, issued by the Chief Economist at the U.S. Department of Commerce, "plants that use advanced technologies pay higher wages, offer more secure jobs, and increase employment more rapidly than other plants."

NACFAM has long held the position that in a post-Cold War era of global economic competitiveness, a larger share of the federal R&D budget should be devoted to aiding the development of new manufacturing process technologies. Even though these technologies are very costly to develop and define the very means of production across all industry sectors, they still represent less than 2% of federal R&D spending.

One of the most promising programs designed to help fill that gap is the Advanced Technology Program at NIST. This program works with industry to develop high-risk, potentially high pay-off technologies that otherwise would not be pursued because of the costs and risk involved and the strong tendency of U.S. companies to invest in short-term product technologies rather than long-term process technologies.

ATP is not confined to manufacturing process technologies, but several of its thrust areas relate to these technologies, such as:

- Manufacturing composite structures
- Materials processing for heavy manufacturing
- Motor vehicle manufacturing
- Computer-integrated manufacturing for electronics
- Manufacturing composite structures
- Component-based software

ATP also helps to resolve one of the major structural failures in the nation's overall science and technology enterprise: the gap between basic research and product development. It is a truism that the U.S. is adept at basic research, but our leading competitors are more efficient at turning that research--including U.S.-based research--into new products. ATP addresses this issue by lowering the risk of technology experimentation and by involving industry directly at each stage of the process.

From the industry perspective, the most attractive feature of ATP is precisely that it is not industrial policy. It is not a top-down program rooted in government agency needs and perceptions.

To the contrary, ATP is based upon proposals conceived by industry, industry proposes the technology focus areas, industry experts are involved in the proposal evaluation process, and industry manages the projects. Indeed, this arrangement prevents ATP from becoming industrial policy.

It is worth recalling that ATP proposals are selected through a merit-based competitive process, not through earmarking. NACFAM has examined this question and has concluded that these are not pork barrel programs. Otherwise, NACFAM would not support or advise that its members participate in these NIST programs.

Given NACFAM's traditionally strong interest in small and medium-sized firms, we are also pleased that over half of ATP awards go to smaller establishments. In this sense, it is not a "corporate" program.

NACFAM has looked carefully at the detailed operations of ATP. Last spring, we convened a meeting in Washington attended by 70 companies who came precisely to offer an in-depth critique of private-public technology partnership programs. Of the various programs discussed, ATP fared very well. It was the strong view of that meeting that ATP was well administered and responsive to the needs of industry.

From the business perspective, the key to success is bringing new and innovative products to market. ATP facilitates experimentation with high-risk technologies that is the gateway--the only gateway--to innovation. Those new products are, in turn, the key to gaining market leadership, especially in those high-valued added areas that increase profits, revenues, produce high wage high skill jobs, and boost exports. On the latter point, it should be noted that while overall trade in manufactured goods suffered a $96 billion deficit in 1992, U.S. trade in "advanced technology products" had a surplus of $35.2 billion that year.

It is difficult at this stage to measure fully the return on investment of ATP. By nature, it is confined to high-risk, pre-product technology development with a longer-term economic impact. However, five independent studies of ATP projects have revealed substantial early impacts, including the following:

- Expanded high-risk R&D
- Gains in research efficiency, including cost and time savings, improved productivity, and other benefits from industry-industry, industry-government, and industry-university collaborations
- Creation and retention of high-wage jobs
- Improved competitive standing
- Formation of valuable strategic business alliances
- Assistance in converting from defense to commercial applications
- Acceleration of technology development

Moreover, NIST reports that information from 40 small participating companies revealed the following impact on commercialization:

- 30 % reported incorporating improvements resulting from the ATP project into existing commercial products
- 18 percent were implementing an improved production process resulting from the ATP project
- 38 percent were producing and shipping to potential customers commercial prototypes of products based on the ATP-funded technology
- 20 percent were producing and selling to customers products derived from the ATP-funded technology.

Another testimony to the favorable impact of ATP is the strong support this program enjoys from industry. For example, the Coalition for Technology Partnerships recently wrote to Congress in favor of this program with over 100 organizations, mostly companies of all sizes, as signatories. This letter states,

> "The real payoff of the ATP is the long-term economic growth potential for the companies involved with the program, and the creation of new jobs. The ATP is a

model of industry/government partnerships which benefits the nation as a whole, again by leveraging industrial capital to pursue new technologies."

Conclusion

Madam Chairwoman, the core issue before your committee in this Congress will be to weigh priorities within the $70 billion-plus federal R&D budget. Most of that budget is still based on a Cold War paradigm: defense-military, space, and big science research. Although there has been some shift towards greater civilian R&D, this has been very gradual. The U.S. still spends considerably less on *non-defense* R&D than its two major competitors as a percentage of GDP.

Among the choices you will make in looking at future priorities within the R&D budget, NACFAM would argue that MEP and ATP are the kinds of federal technology investment that best fit the competitiveness needs of U.S. industry and offer the highest return for the American taxpayer and for the U.S. economy. The fact that industry is contributing its own dollars and manpower is the best guarantee that these programs will yield economic gain.

These programs focus on developing and deploying the technologies of the future. They help close the gap more quickly between basic research, early development and product realization. They save federal dollars through private-public cost-sharing. They stimulate unprecedented teaming arrangements between companies, government, and academia that mirror industry's own growing use of strategic alliances. Neither industry nor government have the ability alone to lead in the global technology race.

In sum, these programs offer an opportunity to pool our national resources to address the technological challenges that face our nation in bringing the industrial base into the Information Age. We must act as a nation on this issue rather than as a divided society.

Rather than choosing to erect new barriers between the private and public sectors, Congress should be seeking ways to break down outdated thinking and practices that inhibit pragmatic cooperation. ATP and MEP together represent well under one percent of the total federal R&D budget. This Congress should join industry, not in reducing or terminating these partnership programs, but in nurturing their success and growth.

Mrs. CUBIN. Thank you, Mr. Reddy.

I think what we will do is go ahead and hear from Mr. Rhoades, and then ask questions of all three of you, if that is satisfactory. And thank you so much for leaving your vacation. That is just more than anyone should be asked to do.

STATEMENT OF MR. LARRY RHOADES, PRESIDENT, EXTRUDE HONE CORPORATION, IRWIN, PENNSYLVANIA

Mr. RHOADES. I am the president of a machine tool company located in Irwin, Pennsylvania, near Pittsburgh. Extrude Hone is a small manufacturer. I can recall making payroll with my personal credit card—never my wife's.

Today we have annual sales of approximately $20 million, and currently employ 180 people; 130 in the U.S. and 50 in 6 technical support centers in Europe and Asia. More than half of our sales are exports.

I appreciate the opportunity to be here today. I believe in the MEP program. I have been associated since 1988 with one of the pioneering efforts in manufacturing extension, the Southwestern Pennsylvania Industrial Resource Center, known as SPIRC, which is one of eight state-funded industrial resource centers in Pennsylvania.

Since 1994, SPIRC, along with three other IRCs in Pennsylvania, have also been national Manufacturing Extension Centers funded through NIST.

I have been a customer, an advisor, and a board member to SPIRC for the past seven years. I currently serve as SPIRC's chairman.

Manufacturing accounts for more than 20 percent of the U.S. GNP and more than two-thirds of U.S. export earnings. Within Pennsylvania, manufacturing comprises over 17 percent of employment, 25 percent of the total wage base, and 33 percent of the gross state product.

Small and medium sized manufacturers are particular important. Most U.S. manufacturers, in fact over 98 percent of them, are small companies. They form the backbone of our production and supplier base, and the employ two-thirds of the manufacturing work force, accounting for over half of U.S. industrial output.

Even more importantly, smaller manufacturing establishments are responsible for the manufacturing sector's only job growth in recent decades. Employment at establishments with more than 500 workers fell by 2 million jobs between 1967 and 1992, while employment in small facilities grew by 1.7 million.

Pittsburgh during the past 15 years lost 150,000 manufacturing jobs mostly in large corporations; 3700 companies employing 170,000 people still remain, comprising 16 percent of the region's work force, and only 250 companies in that region have sales of more than $25 million.

Our challenge in southwestern Pennsylvania, as well as in most other regions, is to help ensure that this base of smaller firms is globally competitive and can continue to provide the foundation that our economy requires.

Many small businesses in the past depended on proximity for their competitive advantage. As transportation has become more efficient, communication technology more advanced, and trade barriers reduced or eliminated, the importance of proximity has also become dramatically reduced.

This has led to a globalization of markets for manufactured products which, because they are conveniently transported and stored, have become the arena to test economic competitiveness among nations.

The following are some observations from a fellow Pennsylvania manufacturer, Art Dodge, from Dodge-Regupol in Lancaster, Pennsylvania, Chairman Walker's District:

Today, the so-called industrialized nations employ 350 million people who are paid an average hourly rate of $18. However, during the past 10 years, the world economy gained access to large and populated countries, such as China, the former Soviet Union, Indian, Mexico. Altogether, it can be estimated that a labor force of some 1,200 million people has become reachable at an average hourly cost of under $2 and, in many regions, under $1.

Consequently, U.S. manufacturers, large and small alike, are under intense global pressures to improve values and reduce costs. In other words, to maintain a significant productivity advantage in the face of rapidly improving productivity in these emerging countries.

This globalization is one of the factors that is profoundly influencing U.S. manufacturing generally. To respond to this, the Nation's largest manufacturers have been feverishly downsizing. This reflects a major paradigm shift in large corporate manufacturing strategy over the past 25 years.

These large companies have concluded in many cases that their internal manufacturing facilities were somewhat parasitic and looked to the corporation's market strengths to carry inefficiencies at in-house manufacturing facilities, which sometimes, they concluded, were irreversibly overpaid and unresponsive.

Their confidence that their changing needs could be met through a dynamic and eager supplier base comprised primarily of small companies contrasts sharply with the vertically integrated operating strategy that built most of those companies over the prior 50 years.

So in order to accomplish this, the Nation's largest manufacturers have in many cases uncoupled their manufacturing operations, which some of them view manufacturing operations as fixed assets that can be held at ransom by a striking work force, they have uncoupled this from their product design and mass marketing strengths.

More and more, manufacturing is being moved out of the large companies that design, advertise, and normally still assemble their products into smaller companies that supply the components in the subassemblies.

They want to harness the responsiveness, efficiency, and creativity of the small company supplier base where top management is pretty close to the factory floor, and resourcefulness is a fiscal necessity.

Most importantly, they want flexibility. In fact, if they had their way, they want interchangeability. They want a supplier base that is plug compatible with their design, procurement, and production integration systems.

Ideally, the supplier relationships will have enough competition to keep everybody's pencils sharp, but enough comfort and stability to justify substantial investments in tooling up at the supplier's expense.

Their vision is the Agile Enterprise, with the ability to assemble virtual corporations from many smaller suppliers who have a standardized quality system, information system, and management approach.

If America's small manufacturers do not respond to this opportunity to adapt to a compatible culture with their Fortune 500 customer base, these major U.S. manufacturers will be forced to turn to an increasingly less distant foreign supplier base who also offer lower wage rates. Fortunately, wage rates are not everything. Efficiency, responsiveness, and particularly quality with a capital "Q" are.

Let me offer some information about my company to explain these challenging opportunities. Extrude Hone is a world leader in a niche market. With occasional help from programs like ATP, the Ben Franklin Program, and the NCMS. We invent new manufacturing processes and the equipment that then carries them out.

We supply our special machines to many of the world's largest and best-known manufacturing companies that help them be more competitive and make their products perform better for their customers.

I have watched and been intimately involved in the development and adoption of new manufacturing processes throughout my entire career. I have managed to learn a few things about this cycle, where the barriers are, how changes in manufacturing operations occur in both large and small companies in the U.S. and other countries, and how sometimes the market is not as all-knowing as it seems.

Regardless of our unique technologies and the stature of our customer base, we too are a small manufacturer with many of the same problems of other small manufacturers. Our competitive differentiation is built on our set of unique technologies, and perhaps our existing market reputation and relationships, but the methods and practices we use to design and build our products are not a lot different or a lot better than other small U.S. builders of industrial equipment.

We know that waste and inefficiency exists in our operations—in manufacturing, design, procurement, and marketing. This waste represents a substantially higher percentage of our sales than do our profits.

Although we have grown about 15 to 20 percent per year by developing new applications and products, we have traditionally earned a percentage of profit on sales which was only average for companies of our size and our industry, and not high enough to adequately finance the growth needed to meet our market demand.

With help and focus from SPIRC, we have managed to nearly double that profit ratio and our goal is to triple it, while at the same time providing more value for our customers for every dollar they spend with us.

Our path to that objective is to implement appropriate, up-to-date manufacturing technologies. If we are successful in our objective, we will have tripled our profitability and built our financial base for growth. Also, by the way, we will have tripled our federal tax payments.

Implementing these changes can be a frightening undertaking, however, for a small company. The capital investment in appropriate manufacturing equipment can be a substantial percentage of the firm's net worth.

Needed changes in manufacturing practices can seem threatening to long-time key employees. Waiting to build the organizational confidence necessary to take these steps can cause long delays in implementing much needed improvements.

Normally that confidence must extend well into the organization before the commitment to change can finally be made. MEP's is particular effective at accelerating that process both through staff and through networking.

I am not sure that the improvements that we have made would have been made without help from SPIRC. They certainly were undertaken much more rapidly and more confidently because of SPIRC's assistance.

We have increasing evidence that the MEP and state programs like it are working. Recently an evaluation of the impact of the Pennsylvania IRC program was carried out, and I have copies of the just-released report for you.

The major findings include 75 percent of the firms reported employment gains since the initial IRC involvement. The firms experienced a net increase in employment of almost 11 percent during a period when total manufacturing in Pennsylvania declined by 10 percent.

83 percent of the firms reported sales gained since the initial involvement, a cumulative gain of over a billion dollars.

The MEP has had a relatively short life history. The original centers have been beacons in unchartered waters that can assist new MEPs like SPIRC to traverse obstacles that they have encountered and overcome before us.

There is good reason to be proud of the accomplishments of the MEP. Its fundamental rationale is intelligent, practical, and needed desperately by an increasingly important segment of our economy that is facing critical and challenging structural changes to its environment.

If the 380,000 small U.S. manufacturers respond unwisely or timidly to these challenges, the 1.7 million American jobs that shifted from large U.S. manufacturing corporations to small ones in the past 25 years could shift again to an increasingly accessible offshore supplier base.

If they respond to these challenges rapidly and with agility, they could indeed fulfill the American Dream for their companies and their 12 million employees.

It makes compellingly good sense for the American taxpayer to see that this critical segment of the economy and the U.S. tax base respond with the best that America has to offer. I urge you to help make that the response by continuing to support NIST's MEP program.

[The prepared statement of Mr. Rhoades follows:]

Testimony before the
U.S. House of Representatives Committee on Science
on the
Manufacturing Extension Partnership (MEP) Program

Presented by
Lawrence J. Rhoades
President, Extrude Hone Corporation
Irwin, Pennsylvania

March 23, 1995

Manufacturing is typically a complex activity. The transformation of raw materials into useful products that provide value for people normally involves dozens to thousands of components, and each component may require ten to one hundred manufacturing operations. All of these components must fit together (sometimes very accurately) and all of them should be completed and ready for assembly at precisely the time they are needed. Because of this complexity, it is not easy to determine where the value added and the waste lie--although new management and measurement tools are making this more evident than in the past.

Sorting out the value added and the waste are what this hearing, the Manufacturing Extension Partnership's mission, and the future of the American manufacturing sector are all about.

My name is Larry Rhoades. I am President and Chief Executive Officer of Extrude Hone Corporation, a machine tool company located in Irwin, Pennsylvania, near Pittsburgh. Extrude Hone is a small manufacturing company. We have annual sales of approximately $20 million and currently employ 180 people--130 in the U.S. and another 50 in five technical support centers in Europe and Asia. I appreciate the opportunity to be here today.

Let me share with you several of my core beliefs about the subject at hand.

First, I believe that a strong manufacturing base is essential to the future of the American economy.

Second, I believe the country's manufacturing economy is particularly dependent upon the existence of a vibrant, growing base of small and medium sized firms that are engaging in world class manufacturing practices and management techniques.

And, third, I believe that it is possible to design and develop effective public programs that support and help make more competitive these smaller firms. In other words, I believe manufacturing extension can and does work and that it represents good public policy and a sound investment of public dollars.

I have been associated since 1988 with one of the pioneering efforts in manufacturing extension--the Southwestern Pennsylvania Industrial Resource Center, known as SPIRC. SPIRC was established through a statewide program created by the Commonwealth of Pennsylvania and is one of eight industrial resource centers in Pennsylvania. Since 1994, SPIRC (along with three other IRC counterparts in Pennsylvania) also has been a national manufacturing extension center, funded through the NIST Manufacturing Extension Partnership (MEP) program. I have been a customer, advisor, and board member to SPIRC over the past seven years. I currently serve as SPIRC's chairman.

I thought it would be useful today to organize my testimony around three principal points:

1. why small and medium-sized companies are important to the future of American manufacturing;

2. why we need a national system or infrastructure to support these firms and help improve their competitiveness; and

3. why I believe manufacturing extension is working and can work even better in the future as a sound public policy investment and tool.

Manufacturing today remains tremendously important to the American economy. It employs over eighteen million people, more than twenty percent of the private sector workforce, and generates four times as many secondary jobs as the service and retail sectors. For the past four decades, manufacturing has consistently accounted for more than twenty percent of the U.S. GNP, and American manufacturers contribute more than two-thirds of U.S. export earnings.

Within my home state of Pennsylvania, a similar pattern exists. Manufacturing comprises over seventeen percent of employment, twenty-five percent of the total wage base, and thirty-three percent of gross state product.

Within this overall context, small and medium-sized manufacturing is particularly important. Most U.S. manufacturers (over ninety-eight percent) are small and medium-sized. In every community and region of the country, they form the backbone of our production and supplier base, employing nearly twelve million people and accounting for over half of U.S. industrial output.

Even more importantly, small and medium-sized manufacturing establishments are responsible for the manufacturing sector's only job growth in recent decades. Employment at establishments with more than five hundred workers fell by two million between 1967 and 1992, while employment at small facilities grew by 1.7 million.

In the future, it is reasonable to believe that these trends will be even more pronounced. Traditional larger manufacturers are emphasizing, above all else, cost reduction. Larger companies are shrinking in size and outsourcing wherever possible. New manufacturing jobs will be created primarily among small and medium-sized companies who will work closely with larger firms as suppliers.

The growing importance of small and medium-sized manufacturing is particularly visible in a region like Pittsburgh which underwent major industrial transformation during the past fifteen years, losing approximately 150,000 manufacturing jobs. Most of these job losses were in large corporations and plants. What remains today is a still substantial base of approximately 3,700 companies employing 170,000 people, or 16% of the region's workforce. But, only 250 of these companies have sales of $25 million or more. Our challenge in southwestern Pennsylvania (as well as in most other regions) is to help ensure that this base of smaller firms is globally competitive and can continue to provide the foundation our economy requires.

This base of smaller manufacturers faces major, ongoing obstacles. They must compete in a global economy, embrace modern management techniques, and deploy advanced manufacturing practices and new methods of work organization. Some are. But, many are operating far below their potential.

Many small businesses in the past depended on proximity for their competitive advantage. As transportation has become more efficient, communication technology more advanced, and trade barriers reduced or eliminated, the importance of proximity has also been dramatically reduced. This has led to a globalization of markets for manufactured products.

However, for most small service businesses, proximity is still highly important. The value of a retail worker or a service provider (like a barber who cannot store and transport one's value added in a product), is still measured in terms of an hour of labor's value in a manufacturing operation and *that* value depends on the *productivity* of the manufacturing operation. Since manufactured products can be rather conveniently transported and stored, they have become the arena to test economic competitiveness among nations.

The following are some observations from a fellow Pennsylvania manufacturer--Arthur Dodge from Dodge-Regupol in Lancaster, Pennsylvania:

> "Last year, an unprecedented legislative process culminated in the signature of the GATT agreement in Marrakech. With the signature of other significant agreements, such as the Single European Act (1986), the Maastrict Treaty (1993) in Europe, and the NAFTA Agreement (1993), about 50,000 pages of new economic rules have been approved.
>
> Today, the so-called industrialized nations employ 350 million people who are paid an average hourly rate of $18 (including benefits). However, during the past 10 years, the world economy gained access to large and populated countries, such as China, the former Soviet Union, India, Mexico, etc. Altogether, it can be estimated that a labor force of some 1,200 million people has become reachable at an average hourly cost of under $2 and, in many regions, under $1."

Consequently, U.S. manufacturers (large and small alike) are under intense global pressures to improve values and reduce costs--in other words, to maintain a significant productivity advantage in the face of rapidly improving productivity in these emerging countries. Even if a U.S. manufacturer is not exporting, he is still competing internationally right here in the U.S.--selling its product head-to-head at Walmart next to competing foreign-made products.

This globalization is one of the factors that is profoundly influencing U.S. manufacturing generally. To respond to this, the nation's largest manufacturers have been continuously and dramatically downsizing. This reflects a major paradigm shift in large corporate manufacturing strategy over the past twenty-five years. These large companies have concluded, in many cases, that their internal manufacturing facilities were sometimes parasitic and looked to the corporations' market strengths to "carry" inefficiencies at in-house manufacturing facilities which they sometimes found were irreversibly overpaid and unresponsive. Their confidence that their changing needs can be met through a dynamic and eager supplier base comprised primarily of small companies, contrasts sharply with the vertically integrated operating strategy that built most of America's largest manufacturing companies over the prior fifty years.

In order to accomplish this, many of the nation's largest manufacturers have uncoupled their manufacturing operations (i.e., fixed assets that can be held at ransom by a striking workforce) from their product design and mass marketing strengths. More and more manufacturing is being moved out of the large companies that design, advertise and normally still assemble their products, into smaller companies that supply the components and subassemblies.

They want to harness the responsiveness, efficiency and creativity of the small company supplier base--where "top management" is quite close to the factory floor and resourcefulness is a fiscal necessity. Most importantly, they want flexibility (in fact, interchangeability). They want a supplier base that is "plug compatible" with their design, procurement and production integration systems. Ideally, these supplier relationships will have enough competition to keep their "pencils sharp" but enough comfort and stability to justify substantial investments in tooling up at the suppliers' expense.

Their vision is the Agile Enterprise--with the ability to assemble "virtual corporations" from many smaller suppliers who have a standardized quality system, information system, and management approach. If America's smaller manufacturers don't respond to this opportunity to adopt a compatible culture with their Fortune 500 customer base, these major U.S. manufacturers will be forced to turn to an increasingly less "distant" foreign supplier base--who also offer lower wage rates. Fortunately, wage rates are not everything--efficiency, responsiveness and particularly Quality (with a big "Q") are.

Let me offer, at this point, some information about my company that might help to explain my perspective on meeting these challenging opportunities. My company is a world leader in a niche market. We develop and implement new manufacturing processes into the industrial base. Our major business is providing the machines that carry out these processes to other (typically larger) firms to use in their facilities. Our principle products are machines and consumables used to perform a process that precisely "hones" edges and surfaces of irregular or complex passages by "extruding" an abrasive filled, putty-like material that acts like "flowable sand paper" as it enters and extrudes through these passages. Thus, our name--Extrude Hone.

We now have a line of a half dozen complementary manufacturing processes, and another half dozen in development. We invent at least one new manufacturing process per year. We supply our machines to customers in forty countries, including many of the world's largest and best known manufacturing companies. I have watched and been intimately involved in the development and adoption of new manufacturing processes throughout my entire career. I have managed to learn a few things about this cycle, what the barriers are, and how changes in manufacturing operations occur in both large and small companies--in the U.S. and in other countries.

Regardless of our unique technologies, and the stature of our customer base, we too are a small manufacturer with many of the same problems of other small manufacturers. Our competitive differentiation is built on our set of unique technologies and perhaps our existing market reputation and relationships, but the methods and practices we use to design and build our products aren't a lot different from (or a lot better than) other small U.S. builders of industrial equipment.

We know that waste and inefficiency exist in our operations--in manufacturing, design, procurement and marketing. This waste represents a substantially higher percentage of our sales than do our profits. Finding and eliminating that waste and inefficiency has a dramatic impact on our profitability. Although we have grown about fifteen to twenty percent per year by developing new processes, products, applications and markets, we have traditionally earned a percentage of profit on sales which was only average for companies of our size in our industry.

With help and focus from SPIRC (our MEP in western Pennsylvania), we've managed to nearly double that profit ratio, and our goal is to triple it while at the same time providing more value to our customers for every dollar they spend on our products. Our path to that objective is to *implement* appropriate up-to-date manufacturing technologies, information systems and management practices. If we are successful in our objective, we will have tripled our profitability and also, by the way, our federal tax payments.

Nevertheless, implementing these changes can be a frightening undertaking for a small company. The capital investment in appropriate manufacturing equipment can be a substantial percentage of the firm's net worth. Needed changes in management practices can seem threatening to long-time, key employees. Waiting to build the organizational confidence necessary to take these steps can cause long delays in implementing much needed improvements. Normally, that confidence must extend well into the organization before the commitment to change will finally be taken.

The MEP is particularly effective at accelerating this process--both through a staff that we have worked with regularly and with whom we have built a trusting one-on-one relationship, and through their ability to facilitate networks of companies within the region. This network facilitation is only one of a number of unique and highly useful MEP roles, but is one that I feel is particularly important and illustrates the special benefits an MEP can provide to small manufacturers.

According to a report from the Manufacturing Studies Board entitled, "Learning to Change--Opportunities to Improve the Performance of Smaller Manufacturers," (National Academy Press, 1993):

> "The manufacturers attending the workshops repeatedly pointed out to the committee that providing occasions (and excuses) for firms within the same, and across radically different, sectors of industry to meet and discuss common concerns and problems were among the most valuable services that a neutral party, such as a MTC, could provide. They felt strongly that the chance for owners and managers to have face-to-face discussions, to exchange information about new methods and technologies, and to hear first-hand how others handled similar business crises was invaluable. Talking with other executives about problems in common is the best way to find out "what works, and what doesn't." Suggested topics included work force training, demographic changes, regulatory compliance, and access to investment capital; sharing stories about solutions attempted and approaches that worked; and comparing ways to respond to so many of the

> problems facing manufacturers today. For some companies this kind of interaction is sufficient motivation for them to begin significantly attacking their competitiveness problems. Many companies are surprised to learn that they have so many of the same problems and that help is available.
>
> Even when staff and directors of assistance organizations have business and manufacturing backgrounds, their experiences and the problems they faced, in general, are different from what the owners and managers felt they were confronting today. They appreciated the expertise and experience of the assistance groups but they felt that the opportunity to speak with people that shared their same problems and challenges on a daily basis was especially valuable."

MEP facilitated networking overcomes the normal isolation of small companies from one another. I feel that one of the greatest values of *local* MEP networking is that because it is local, it is easy for a number of decision makers in a company to visit neighboring companies who have faced similar decisions to learn from their experiences--good, bad or mixed. Most importantly, it permits the entire company team to "envision the change"--to imagine its implementation in *their* company. It is that ability to envision the change that clarifies and accelerates its implementation.

In my opinion, this network can only be facilitated by the type of organizations that MEP has created or supported. These non-profit, yet industry driven, organizations are recognized by the companies they serve as being devoted to the collective interests of the region's smaller manufacturers--above all else. Consequently, these companies are willing to participate actively in the network. Experience at one of the early MEP's has shown that organizing these networks properly and managing them carefully is critical for them to be effective.
Learning how to do this effectively is one of the most compelling reasons for a *national* Manufacturing Extension Partnership rather than a patchwork of local and state efforts. A unique and extremely useful knowledge base has been developed through the original MEP's six-year history that provides important insights and a clearer understanding of the process of Manufacturing Extension Partnering. These centers are beacons in uncharted waters that can assist newer MEP's, like SPIRC, to traverse obstacles they have encountered and overcome previously.

Does manufacturing extension work? I believe it does. On an individual firm basis, I have seen first hand at Extrude Hone what an MEP center can do to help a company modernize and improve their competitive edge. From identifying and focusing our attention on our most significant sources of inefficiency and waste through an Operations Review, SPIRC went on to help us evaluate both a Local Area Network (LAN) and an advanced Computer-Aided Design (CAD) system to reduce this waste. SPIRC then directed us to a state financing program and a local foundation-supported loan fund to help us finance the installation of these systems. I'm not sure that we would have taken these commitments at all without SPIRC. They certainly were undertaken more rapidly and more confidently because of SPIRC's assistance.

Perhaps more importantly, the very positive results we experienced from these investments have made my company and my colleagues far more proactive in making investments and organizational changes in anticipation of critical needs--rather than simply waiting until circumstances forced a commitment to change that sometimes was a poor compromise between what was needed and what we could squeeze out of near-term cash flow. The improved information for management, manufacturing and marketing provided by the LAN computer system and the improved design efficiency from the CAD upgrades provided important contributions to our steadily improving profit-to-sales ratios. At the same time, our customer satisfaction levels have improved as our product quality and responsiveness have increased. We are now looking to SPIRC and the SPIRC network to assist us in Benchmarking and ISO 9000 certification.

More broadly, we have increasing evidence that the MEP, and state programs like it, are working. As I mentioned earlier, Pennsylvania has operated its own Industrial Resource Center program since 1988. Recently, an evaluation of the impact of this program was carried out by the Pennsylvania Economy League, a respected, non-partisan, non-profit economic research organization. This study was based on nearly 300 randomly selected manufacturing firms in the state who have been IRC clients. The major findings included:

- 75% of the firms reported employment gains since the initial IRC involvement;

- The firms experienced a net increase in employment of almost 11% (during a period when total manufacturing employment in Pennsylvania declined by 10%);

- 83% of the firms reported sales gains since the initial IRC involvement, a cumulative gain of over $1 billion.

- 64% of the firms indicated that they export, and 80% of these reported increases in export sales.

Nationally, similar findings are being reported. A recent study based on a 1994 Dun & Bradstreet survey found that small and medium-sized manufacturers served by MEP centers are up to six times more likely to organize specific improvement actions than small manufacturers not assisted by a center.

The MEP has had a relatively short life history. Begun in the late 1980's, it only began in the last year to move beyond the original MTC's to supporting and developing a national system that could address the manufacturing competitiveness issue on a broad and equitable front.

There is good reason to be proud of the accomplishments of the MEP. Its fundamental rationale is intelligent, practical and needed desperately by an increasingly important segment of our economy that is facing critical and challenging structural changes to its environment.

If the 381,000 small U.S. manufacturers respond unwisely or timidly to these challenges, the 1.7 million American jobs that shifted from large U.S. manufacturing corporations to small ones in the past 25 years could shift again to an increasingly accessible off-shore supplier base. If they respond to these changes rapidly and with "agility," they could indeed fulfill the American Dream for their companies and their twelve million employees.

It makes compellingly good sense for the American taxpayer to see that this critical segment of the economy--and the U.S. tax base--responds with the best that America has to offer. I urge you to help make *that* the response by continuing to support NIST's Manufacturing Extension Partnership.

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LAWRENCE J. RHOADES

Larry Rhoades is President of Extrude Hone Corporation, one of the leaders in the field of nontraditional machining, finishing and measurement. He holds numerous patents and has authored a variety of works related to deburring, finishing and nonconventional machining methods. Mr. Rhoades graduated from Brown University where he studied Economics and Mechanical Engineering; he received an MBA from Northwestern University.

In 1987, he was appointed to the Advisory Committee of the Export Import Bank of the United States and served as Chairman of this committee in 1988. Mr. Rhoades was named the 1989 Small Business Exporter of the Year by the Commonwealth of Pennsylvania. He is a member of the Western Pennsylvania District Export Council and serves on the Board of the World Trade Center Pittsburgh.

At the University of Pittsburgh, he is a member of the Advisory Committee of the Manufacturing Systems Engineering Program and the Board of Visitors of the Mechanical Engineering Department.

He chairs the Board of Directors of the Southwestern Pennsylvania Industrial Resource Center (a NIST MEP), and is a member of the Board of Concurrent Technologies Corporation which operates several DoD Centers of Excellence.

Mr. Rhoades has served on the Board of Directors of the Association for Manufacturing Technology (AMT), and has chaired its International Trade Committee and its Show Committee which is responsible for IMTS, the country's major machine tool show. He currently serves on the AMT's Government Relations Committee.

Mr. Rhoades has served in a number of capacities in the Society of Manufacturing Engineers, and currently chairs APEX--the Advisory Committee for its machine tool exhibitions.

Mr. Rhoades is a founding member of the National Center for Manufacturing Sciences, and serves as Vice Chairman of its Technology Review Board.

In 1991 and 1994, he provided testimony to the U.S. Senate Armed Services Committee and is an Executive Committee member of the Multi-Association Industry Task Force on Affordability advising the Defense Manufacturing Council.

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Mrs. CUBIN. Thank you very much. Thank all of you for your testimony.

I just have a brief comment to make before I ask a question. I am from the State of Wyoming. In Wyoming, the vast majority of our people are now employed in small businesses. We used to be primarily, the labor force was in minerals' extraction, but now small business has taken over.

So I understand the problems of proximity to markets and to supplies and that kind of thing. So I think this is particularly important to a State like mine.

What I wanted to ask you, current law provides for six years of federal funding for the manufacturing centers. I wonder how many years have you received funding from the center program?

Mr. RHOADES. Funding started for our program from the MEP, from NIST, only in 1994. So it only started a year ago.

The Industrial Resource Center system was started in Pennsylvania with state funding in 1988. So that had existed.

There are very significant differences that have occurred in that organization since it became an MEP. Not only is the scale upgraded, but being part of a national network very much helps.

Having sat in on some reviews of MEPs, there are many lessons that they have learned in the pilot centers in the first six years that are very important for us as new centers to be learning from them, and what works and what doesn't work.

So to that extent, I think that they are very useful as pilots and as guides for those of us that are just starting out.

Mrs. CUBIN. What will be the direct effect on your center after the six years is up?

Mr. RHOADES. Well, we expect that within the six years we need to try to become—wean ourselves from the need for public funding.

The difficulty is that some of the most important benefits like network facilitation are not things that can be charged for.

Charging for network facilitation in effort after effort doesn't work, and yet that is the most powerful factor for small companies to work with.

The important factor there is that with a network, if you are contemplating change, you can then use the network facilitation to go visit neighboring companies that are—that have already taken the step that you are contemplating and, not only I can go visit them, but deep within my organization I can take a lot of people over there.

The important thing for them is to envision the change; to imagine that change occurring within their organization. Once that envisioning is done, then the clarity and acceleration of the implementation of the new method or the investment becomes much, much easier. But investment is a big thing for these small companies.

Mrs. CUBIN. How does a company that hasn't been involved, then, get into the networking which seems to have the longest lasting value after the six years is up?

Mr. RHOADES. I don't think that that kind of thing will be able to be maintained. You certainly can't charge a fee for service. So the organization may earn enough from other activities to be able to subsidize that, so I am not sure what will happen after six years.

There is a great deal of value that can be gained in six years. I think the structure of the MEP program that encourages, and in fact insists upon fee for service, that there is a declining rate of taxpayer support for these services that is a very intelligent one and that brings discipline to the process.

But to be completely self-sufficient would change the nature of the activity in a way that would not necessarily be positive.

I do not think you could generate the level of community support if it were purely for-profit.

So it needs to be funded somehow, from state, federal, and fees as a combination.

Mrs. CUBIN. Thank you.

Mr. RHOADES. If the MEP program stops in six years, it would hurt.

Mrs. CUBIN. Thank you.

Does the gentlelady from California have any questions?

Ms. LOFGREN. Very quickly, I am interested in your last question.

For any of the panelists, what would the impact be if the Congress were to require the MEPs to be self-sufficient next fiscal year in terms of charging fees?

Who would lose out?

Who would not be served?

What would the impact be, in your judgment, on the economic vitality of our country?

Mr. REDDY. If I could make one or two comments on that, and also ask Ms. Pounds to comment since she is actually running one of those centers.

From the industry perspective, the companies in my coalition are very insistent upon rigorous review, performance standards, and so forth.

But, quite frankly, we think that of the different—certainly of the different federal technology programs, this particular program sets higher requirements for performance measurement and data collection on performance than any other that we know. That doesn't mean the performance—

Ms. LOFGREN. Let me clarify. I am not asking it because I think it is a good idea.

Mr. REDDY. Yes.

Ms. LOFGREN. I am just trying—as a matter of fact, I do not think it is a good idea. I am just wondering if you could tell me what you think the impact would be.

Mr. REDDY. We think that rigorous review is appropriate.

I agree with Larry completely about the need to move more toward a fee-based service.

But putting a six-year time limit on it does not address the two points I mentioned. In other words, there are structural failures in our economy basically in terms of meeting the needs of small companies. A six-year time limit is not going to resolve that problem.

I think what will really happen—and Ms. Pounds can confirm that—is that probably these centers will not go out of existence, but they will change their nature. They will become for-profit organizations, and they will have to look for their business among larger companies. They will be unable in the future to serve many small companies.

Ms. LOFGREN. So it would be the smaller entities who might need the most help who would be least likely to receive it.

Mr. REDDY. That is right. You are withdrawing exactly the support for which we have these centers in the first place.

Mrs. CUBIN. It appears we are playing musical chairs. I am going to turn this back to Congressman Gutknecht, and he will have some questions, also.

Thank you for being here.

Ms. POUNDS. As Mr. Reddy has said, the two largest impacts that it would have on my particular center would be that immediately I would have to change my focus for the customers that we serve.

The customer profile in Massachusetts is 87 percent have less than 10 employees. I would have to—to be able to make up that extra money just on fee generation alone—I would have to target the companies that were over 100 or 250 employees, and thus not even reach 87 percent of the customer base.

The other thing that it would change is that more than likely I would have to bring more expertise in-house. I would not look to leverage it in the current private sector from the consultants, or from the universities, or the community colleges where we partner right now for those services.

To do it that quickly would mean that I would have to bring that expertise in-house, and it would cause a different dynamic in the services we deliver, and in not forming the partnerships that would be long-lasting in our State, or for the companies.

Mr. RHOADES. One of the biggest concerns that I have is to see that the lessons learned by those that have been creating this craft, there is not an existing training ground for manufacturing extension professionalists other than the MEP program.

There are the state programs which have been run individually, but having a national program and being able to learn lessons, and to really learn them—you cannot learn these with a few-day visit—when I reviewed the Cleveland Center about a year ago, my greatest interest was to see that we could use that center as a university or as a training ground for the professionals in the newly started program in Pennsylvania.

So I think that having those early programs around to help train the rest of us is very important.

In time, as professional infrastructure gets built up, and as we all learn how to do these things more efficiently, there is enough value created that hopefully at some point in time there will be ways to extract payment for that in ways that do not kill the program.

But as in the ATP effort, a great deal of the value created is not something one can capture and charge for. If you invent a new process, 98, 99-plus percent of the value of that is going to go to the people who use it, and their customers, and you are not going to be able to build a fence around it or to extract that much.

The same thing will happen within the MEP effort. You just cannot—right now we do not know how to charge for that.

There is so much value created, that I can hope that in six years there will be ways to charge for that.

Ms. LOFGREN. Thanks very much. Thanks especially for coming back from such a sunny, wonderful place and talking to us.

Mr. RHOADES. Thank you.

Mr. GUTKNECHT [PRESIDING]. Mark Twain once observed—I think it was Mark Twain—that the closest thing to Immortality in this World is a government program.

[Laughter.]

Mr. GUTKNECHT. You are among the small and elite group that actually have a government program that has some kind of a sunset.

I guess I would like to ask, have you begun to think about what happens when the funding runs out after six years, where you will go?

Mr. RHOADES. Yes. We have begun to think about that immediately in a program that is just starting. We realize that there are some things that we can pass on fees for, and we plan to increase the level of those fees as time goes on, so there is a point in time where we could see that possibly this thing could be completely self-sufficient for many of its activities.

On the other hand, there are activities that will not be self-sufficient.

The most important of those is networking, in my view. Charging for networking just kills the network. And the biggest value on that is to find mentors for smaller companies. So there will be three things that will happen.

First of all, if you sunset the existing centers, the early pilot centers, we lose those as a guide.

Secondly, because I am a new center, if as we sunset over six years there will be a need to look at the value added and the value captured, the charges that we can recover from each of those engagements. So that we won't do things not because they won't create enough value for the public or for the taxpayer to justify them, but because we cannot charge the fare for it. It is like a mass transit system.

You just end up with that, and that's—So you can do that, and everybody can drive cars, but everybody will then work to their own limits on what they can justify spending their company's money for.

Ms. POUNDS. We certainly have been struggling with this almost on a daily basis because, as Mr. Rhoades says, there are so many pieces of our business in just the casual assessment that you do with a company, the ways that you are able to provide them information either one on one or in groups are not something that can be charged for at this point.

Nor, do the small companies want to be charged for it. But they do want to have that information available to them because they cannot find it right now.

They do not want to be sold a solution that is not applicable for their company.

We have looked at certainly a model—NIST/MEP has looked at a model for the years that would have a third federal funding, a third state, and a third private industry contributions.

That is a model certainly that as the older centers are getting to that six-year window, they are finding is a very effective level.

What the third of federal funds would continue to bring to the center is tying them together in a national system so that they are not just looking at a state perspective, or an industry perspective.

What the state piece does is provide for the industries in their state and specific areas. We certainly would want to try to increase that private investment in even more ways.

Right now the struggle is. How do we not become a private, for-profit driven entity and increase that fund when what we are trying to do is provide the access to information and resources that they cannot get right now in the private sector. There is a market failure in them being able to access it.

Mr. RHOADES. If I could make one more comment on that issue?

Mr. GUTKNECHT. Sure.

Mr. RHOADES. I am not sure that it is good public policy to want to shut this kind of program down after six years when one considers that there is a very direct impact from what this program does to increase corporate profits, even for very small companies who are the vast majority of manufacturing now.

The government takes a considerable interest in those profits because that is a very variable part of their tax base, and corporate profits will vary by more than personal income will.

The ability to enhance those profits and enhance the revenue that is generated by the taxes on those corporate profits provides significant incentive for government to want to make that investment for the sole purpose of maximizing the tax take on the corporate profits.

Now I realize that is not what government is in business to do, but in terms of justification for the investment, I do not know of one that is more direct.

Mr. GUTKNECHT. Mr. Reddy, would you like to comment?

Mr. REDDY. I commented earlier. Just to make the point, and reinforce what Ms. Pounds said, that we are convinced, having looked hard at these centers, that if they were to work solely on their own, they would quite quickly for their own survival have to gravitate back up the line to the larger customers.

Therefore, they would not be there to meet the structural weaknesses, the market failures that are out there for smaller companies.

Mr. GUTKNECHT. So if I understand what you all are saying, it is that long term if you are going to really complete your mission, that there has to be some level of support from the Federal Government? Is that accurate?

Mr. RHOADES. It could be from the state, but there needs to be some public support.

Mr. GUTKNECHT. Ms. Pounds?

Ms. POUNDS. There does need to be some level of public support.

My fear would be that if it was just state support we would not have a national system. We would not look at the competitiveness of all manufacturers similar to what other countries are doing and investing in their small manufacturing base.

We have become very tied to what the large companies wanted from their suppliers, or the large companies would have to start bringing that expertise back in-house and vertically integrating again, and they themselves would then become outdated one more time.

So if the federal support was not there, the small companies would not be served—except in very specific industries that were important to a particular state.

Mr. GUTKNECHT. Well, listen. I want to thank you all. This is a very interesting subject, and I want to thank the panel—this panel and the previous panels. I think there is going to be an ongoing debate about this.

As I indicated to one of the other panelists, we are hearing more and more the term "corporate welfare" being kicked around this place.

Some of us are going to wind up on one side, either defending or joining the assault, and the ammunition you provided today I think has been very helpful. We appreciate your testimony.

I would ask, though, that there may be some Members who might like to submit some questions to you in writing at some point in the future. I wonder if you would indulge those questions, as well?

Ms. POUNDS. [Nods in the affirmative.]

Mr. RHOADES. [Nods in the affirmative.]

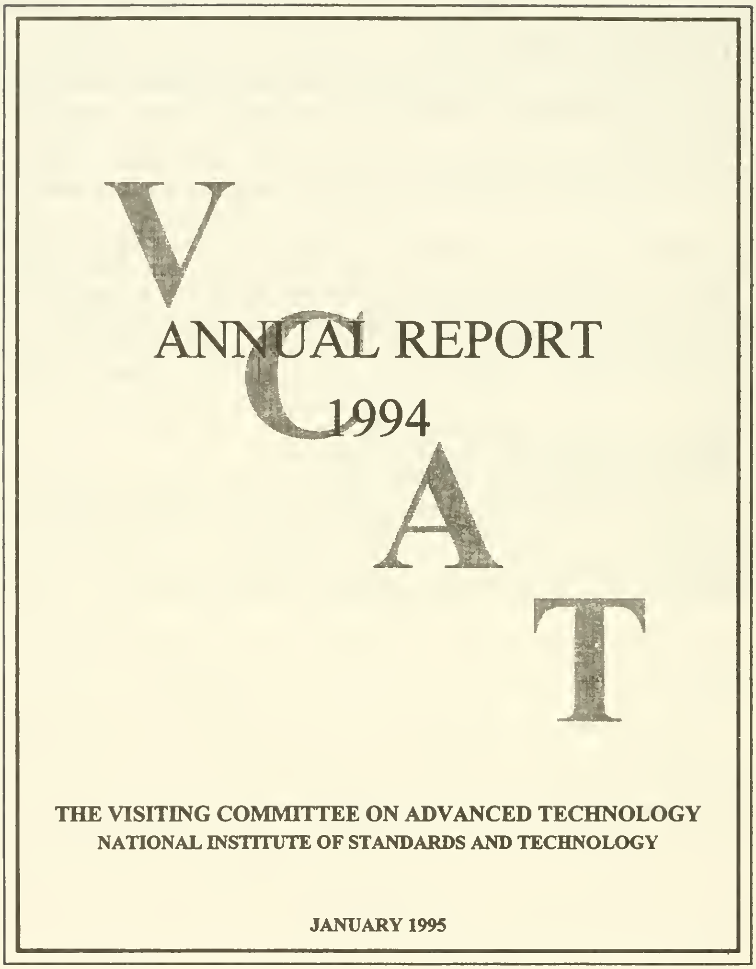
Mr. REDDY. [Nods in the affirmative.]

Mr. GUTKNECHT. You are all nodding in the affirmative, I believe, so with that I will adjourn the committee.

Thank you.

[Whereupon, at 5:10 p.m., the hearing was adjourned.]

APPENDIX I



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NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

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THE VISITING COMMITTEE ON ADVANCED TECHNOLOGY 1994

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FOREWORD

Continuing the pattern of recent years, 1994 was a year of change and growth for NIST. Both the Administration and the Congress have continued to make technology a priority, with the Department of Commerce being a key player. The Department shows strong interest in and budget support for technology development and NIST's industrial support mission. The Fiscal Year 1995 budget appropriation, which includes substantial increases for NIST programs across the board in a time of tight budgets government wide, demonstrates the government's commitment and gives NIST the means to expand and enhance its industrial outreach programs and to take more control of its research agenda.

NIST's new Director, Arati Prabhakar, is now in her second year and has earned the respect of the Institute's researchers and its constituents through her effective leadership. She continues to be a very visible and articulate spokesperson for NIST and for its collaboration with and support of U.S. industry. Under her leadership, the Advanced Technology Program has expanded to include focused program competitions, as recommended by the Visiting Committee. Five such competitions have been held, with six more announced in December 1994.

During the year, we asked many people both within and outside of NIST for information and opinions as we conducted our studies of NIST policies and programs. We thank the NIST Director and her staff, the Program and Budget Offices, the Operating Unit Directors, and research scientists from across NIST who made presentations at our meetings and responded to requests for information. We also received requests for and comments on the reports and statements that we prepared. We thank all those who responded.

The Visiting Committee on Advanced Technology

January 1995

EXECUTIVE SUMMARY

Strategic Planning

NIST has become an integrated technology, industrial outreach, and quality resource for U.S. industry with four primary program areas: laboratory science and engineering research, the Advanced Technology Program, the Manufacturing Extension Partnership, and the Malcolm Baldrige National Quality Award Program. Much of NIST's strategic effort this year has concerned the setting of priorities and the measurement and assessment of effectiveness of each of these programs, i.e., the impact on customers in industry and elsewhere. A paper was issued by NIST in January 1994 which presents how NIST is addressing these issues. In our opinion, a good start has been made on the setting of priorities and the assessment of impacts.

Strategic planning in the individual laboratories continues to improve. In NIST reviews of the laboratories, held early in 1994, strategic planning focused on a few major goals for each laboratory and several objectives under these goals. However, further progress is needed in developing quantitative goals and measures for assessing progress toward them. Furthermore, we believe that the laboratories should analyze and manage their programs in terms of a portfolio addressing major industry needs.

A difficult issue which continues to face the laboratories is the prioritization of industrial needs that can be addressed by unique NIST capabilities. Through numerous workshops, collaborations, and visits, NIST staff are kept informed of these needs. However, the laboratories' resources are limited and must be used to greatest effect. Furthermore, NIST hosts hundreds of outside scientists and engineers each year, and appears to be at or near saturation in its ability to respond to external demands. Many of the workshops and planning meetings are now structured to provide prioritized assessments of industrial needs. We support such assessments and encourage their use in additional areas.

Strategic planning should include ideas from all parts of the organization and create a common sense of purpose. We were therefore pleased to hear that several of the laboratories presented their strategic plans in open meetings with their staffs. Keeping the staff well-informed and engaged in strategic planning is essential for all of NIST's operating units.

Programs and Issues

The NIST laboratories received a 17% appropriations increase in Fiscal Year 1995. NIST plans to continue to use the new money to take greater charge of its research agenda and implement its strategic vision. This will be accomplished by replacing contract research that is not strongly tied to NIST's industrial support mission or otherwise crucial to the national interest with more mission-focused, base-funded research. The Fiscal Year 1995 increase, combined with the Fiscal Year 1994 increase of 17%, will allow NIST to reduce the amount of other agency (non-DOC) funded research to about 25% of laboratory funding. We fully support this strategy, which emphasizes quality and mission focus rather than staff growth.

In our opinion, the single most important problem to the long-term institutional health of the NIST laboratories continues to be the substandard condition of the physical plant. However, NIST's Capital Improvement Facilities Program (CIFP) is beginning to address the need for a major upgrade and renovation of NIST laboratories to overcome serious technical obsolescence and safety problems. Two new Advanced Technology Laboratories (ATL), one in Gaithersburg and one in Boulder, will house those research programs that demand the highest quality laboratory environments. We believe that building laboratories that will support world-class research for many years to come will be critical to NIST's ability to contribute at the cutting edge of technology. In addition to the ATLs and the limited major renovations now underway with the CIFP, NIST must find ways to address the technical obsolescence and degradation due to age of their other facilities.

The Advanced Technology Program (ATP) is supporting the development of many important enabling technologies and shows excellent short-term indicators of success. In order to accelerate progress in key technology areas that will have the maximum impact on U.S. technological competitiveness, NIST has added focused competitions to its ongoing general competitions. We support this strategy. General competitions support innovative ideas in all areas, while focused competitions, developed with the advice of industry, support technologies with special strategic importance. Six ATP competitions were recently completed, with 32 awards in the general competition, and 56 awards in five focused competitions. Six new focused areas were announced.

The Manufacturing Extension Partnership (MEP) is a growing success. During 1994, the previous seven Centers were joined by 28 new Centers. Increased funding in Fiscal Year 1995 will provide for a total of 80 Centers, of which 37 will be funded by the Defense Department's Technology Reinvestment Program (TRP) and managed by MEP. Planning calls for a total of 100 Centers by the end of Fiscal Year 1997, all funded through MEP. Managing this rapid expansion will be a challenge. However, NIST appears to have planned well for the task.

The existing Centers have become technology hubs in their regions, and thousands of small companies have received valuable support and assistance. Client evaluation surveys show a large return on the MEP investment. The MEP is now making the transition from an incubator of manufacturing technology centers to a national manufacturing support network. In order to maintain a focus on the needs of small manufacturers, we recommend consideration of continued funding to centers beyond the sixth year of operation, for those that have demonstrated satisfactory performance. MEP also plans to integrate the centers into a truly national system through electronic linkages and strategic partnerships with other government and private organizations. We strongly support the MEP plan.

The Malcolm Baldrige National Quality Award has increased enormously the understanding and application of quality principles in this country. In doing so, it has become a national institution and a rallying point for quality improvement. The program is now gearing up to address new challenges. In the last budget submission, the program proposed to work with the education and health care industries to enhance their quality performance, conduct research and disseminate information on quality management strategies, and build on the worldwide reputation of the Baldrige award to enhance the quality image of U.S. exports. We supported all of these proposals; however, the only funding increase was for a pilot program to formulate a set of Baldrige-like criteria in education and health care. We encourage NIST to strengthen their proposal and resubmit it in the next budget cycle.

In each of the last three years, applications for the Baldrige award have declined. This is not entirely unexpected, as many companies come to understand what it requires to be world-class performers. We support the rigorous standards that make the Baldrige award the pinnacle of quality achievement in the United States. At the same time, we are pleased that NIST has streamlined the Baldrige award criteria, reducing the number of areas to be addressed while providing a sharper focus on key business strategies.

NIST has announced plans to combine the present Computing and Applied Mathematics Laboratory with the Computer Systems Laboratory to form a new Information Technology Laboratory. We believe that this can strengthen NIST's ability to develop enabling technologies in support of interoperability and standards in an area vital to the United States.

Key challenges facing NIST are to replace the very successful Director of the Advanced Technology Program who will retire early in 1995, to recruit a Director for the new Information Technology Laboratory, and to appoint a permanent Director for the Manufacturing Extension Partnership. These are critical areas for NIST which require outstanding technical competence and leadership.

INTRODUCTION

Committee Charter and 1994 Activities

The Visiting Committee on Advanced Technology of the National Institute of Standards and Technology (NIST) was established by the Omnibus Trade and Competitiveness Act of 1988. The committee reviews and makes recommendations regarding the general policy, organization, budget, and programs of the Institute.

The committee holds four business meetings each year with NIST management and schedules additional meetings on specific subjects as necessary with senior officials from NIST and the Department of Commerce. In January 1994, the committee met with the Secretary of Commerce and other senior department officials to summarize its findings and recommendations in 1993 and to discuss its agenda for 1994.

The committee summarizes its findings each year in an annual report that is submitted to the Secretary of Commerce and transmitted by the Secretary to Congress. The report addresses issues that affect NIST or are of concern to the committee in its role as NIST's private sector policy advisor. A central theme of this year's annual report is NIST's progress toward becoming a leading national technology and quality resource, with emphasis on how NIST defines, prioritizes, and manages its programs in support of industry from a strategic standpoint. We review and comment on current issues in the Institute's laboratories and program areas. We also discuss the NIST facilities initiative, which we believe is crucial to the long-term institutional health of the NIST laboratories.

Each year, the committee conducts studies and prepares additional reports on specific policy matters as it deems appropriate. This year, the Committee has focused on the Advanced Technology Program with emphasis on the development of focused programs and on the management of the growing number of awards. In order to include a discussion of recently announced awards and focused programs, a complete report will be issued in 1995. A brief version is contained in this Annual Report.

Appendix A of this report summarizes the Visiting Committee's meetings, reports, and other activities for 1994. The appendix also gives the address from which the Visiting Committee reports and other information on committee activities can be obtained.

STRATEGIC PLANNING

NIST Planning

During the past year, the substantial changes at NIST which followed from the Omnibus Trade and Competitiveness Act of 1988 have continued. Based on the solid foundation of its highly respected laboratories and its long tradition of working with industry, NIST has become an integrated technology, industrial outreach, and quality resource for U.S. industry. With continued support from the Department of Commerce, the Administration, and the Congress, NIST is pursuing a bold strategy to increase its national leadership role in civilian technology.

The NIST mission is to promote U.S. economic growth by working with industry to develop and apply technology, measurements, and standards. It carries out this mission through four primary program areas:

- a strong laboratory effort planned and implemented in cooperation with industry and focused on infrastructural technologies, such as measurements, standards, evaluated data, and test methods;
- a competitive Advanced Technology Program which provides cost-shared grants to industry to develop high-risk technologies that can enable significant commercial advances;
- a grassroots Manufacturing Extension Partnership program which helps small and medium-sized companies to adopt new technologies; and
- a far-reaching quality improvement program associated with the Malcolm Baldrige National Quality Award.

The laboratories have reformulated their mission statements to reflect the NIST mission.

The laboratories and the quality and outreach programs are independent operating units, as shown in Figure 1. However, the traditional NIST laboratory culture, with its emphasis on technical excellence, objectivity, and cooperation, has taken root in the outreach and quality programs, which have up to now been managed and largely staffed by former laboratory employees. In recognition that its newer

National Institute of Standards and Technology

Organizational Chart

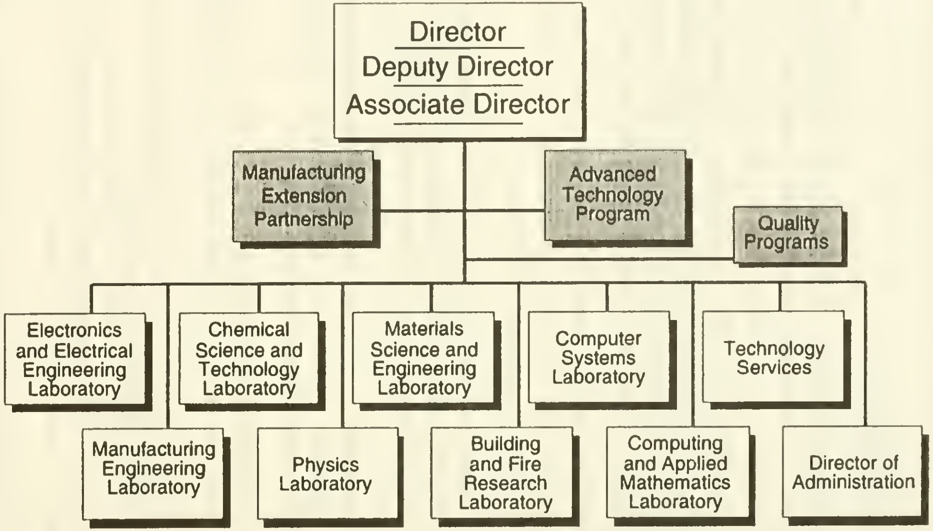
Director
Deputy Director
Associate Director
Manufacturing Extension Partnership
Advanced Technology Program
Quality Programs
Electronics and Electrical Engineering Laboratory
Manufacturing Engineering Laboratory
Chemical Science and Technology Laboratory
Physics Laboratory
Materials Science and Engineering Laboratory
Building and Fire Research Laboratory
Computer Systems Laboratory
Computing and Applied Mathematics Laboratory
Technology Services
Director of Administration

Figure 1

programs need additional skills and knowledge, NIST has added some staff from outside of NIST as these programs have grown. For example, the Advanced Technology Program must be entrepreneurial and willing to take risks; the Manufacturing Extension Partnership must understand regional economies and technology needs and the small business culture. As these programs grow, the commitment to quality and an industrial focus must be maintained, and any new leadership added must be committed to the NIST culture of technical excellence and objectivity. We would like to note that progress is being made in linking the outreach programs to the laboratory programs. The Advanced Technology Program has increased its funding of laboratory programs in direct support of successful proposals, but this funding is still a small proportion (about 5.0%) of the total program. The Manufacturing Extension Partnership is actively planning to increase its interactions with the laboratories.

In our 1993 report (1) we stated that one of NIST's main strategic planning goals should be the integration of institute-level and operating unit plans. Planning at both levels continues to improve. NIST has laid out a clear strategy and communicated it to the operating units through offsite sessions and to the staff through two major presentations by the NIST Director. Operating unit plans are reviewed in a series of base reviews which provide the basis for future base funding decisions. In 1995 we plan to review how the operating unit strategic plans are responding to the NIST strategy.

We continue to be encouraged by what is going on at NIST and within the Department of Commerce. NIST continues to respond vigorously to the responsibilities and opportunities that come with significantly increased funding in its four major program areas. Secretary Brown and Under Secretary for Technology Good continue to give technology and competitiveness priority within the Department and to give NIST strong support in its technology role. There is broad-based Federal and private sector support for NIST's mission. A substantial increase in NIST's Fiscal Year 1995 appropriation, coming on top of a similar increase in Fiscal Year 1994, has increased the enthusiasm and optimism at NIST.

Setting Priorities and Measuring Results

Much of NIST's strategic effort this year has concerned the setting of priorities and the measurement and assessment of effectiveness of each of the four major program areas, that is, the impact on customers in industry and elsewhere. A report, "Setting Priorities and Measuring Results at the National Institute of Standards and Technology," (2) was issued by NIST in January 1994. This report discusses how NIST is addressing these issues. The operational aim is to focus and leverage Federal expenditures so that relatively small investments yield meaningful economic benefits for the nation. Priorities are set, operational performance is evaluated, and near- and long-term returns are assessed on the basis of benefits realized by U.S. industry. We believe that this is a sound and essential approach during a time of constrained Federal budgets and growing economic competition. Furthermore, even though the NIST budget is planned to increase significantly by Fiscal Year 1997, it will still be less than one percent of the total Federal R&D expenditures.

Interactions with U.S. Industry

There are many mechanisms used by NIST to interact with industry. These range from problem-solving telephone calls to more formal and long-term collaborations, including cooperative R&D agreements (CRADAs), R&D contracts, workshops, guest researcher agreements, patent licenses, and research consortia involving several companies and NIST. Direct assistance is available to smaller manufacturers from the NIST manufacturing extension centers. Many of NIST's interactions with industry grow out of NIST's extramural programs.

NIST recently issued a report (3) which discusses 38 examples of industrial impacts which have resulted from NIST's extramural programs and its interactions with U.S. industry. These examples, which involve 59 companies, describe new products, accelerated R&D, and increased efficiencies resulting from NIST's programs and interactions.

PROGRAMS AND ISSUES

In this section we comment on NIST's programs, with emphasis on management issues.

Laboratory Programs

At the heart of NIST are eight laboratories which carry out a strong research and development effort, planned and implemented in cooperation with industry, to address industry's needs for generic measurement technology, measurement standards, calibrations, test methods, and evaluated data. NIST's reputation for impartiality and technical excellence allows it to act as an independent third party in resolving technical problems and in bringing industry together to anticipate future needs for measurement technology.

The laboratories use a variety of mechanisms to determine and prioritize industry needs. These mechanisms include NIST-convened conferences, workshops, surveys, informal meetings, and direct company interactions. In October 1994, a NIST-wide staff seminar was held on the topic "How to Assess Industry's Needs in Setting NIST Laboratory Priorities," in order to inform the staff about the most successful of these mechanisms. In December 1994 a second staff seminar was held on the topic "How to Measure the Impact of NIST Laboratory Programs." Both seminars were hosted by the NIST Director and were well-attended. We commend NIST's efforts to set priorities and measure results; these are especially critical during a time of growing budgets and increasing expectations.

Operating Strategy and Laboratory Funding

In view of the President's Fiscal Year 1995 economic plan, which calls for increasing NIST's total budget from $384 million in Fiscal Year 1993 to $1.4 billion in Fiscal Year 1997, we asked NIST management to discuss their operating strategies and their approach to laboratory funding. They assured us that the qualities which define NIST, namely technical excellence, integrity, objectivity, and collaboration with U.S. industry, would not change. The rate of evolutionary change for technical projects in the laboratories should be about 20% each year, while revolutionary change is being experienced in the outreach programs. Constant attention will be paid to setting priorities and measuring results. NIST intends to move from a hierarchical to a participatory management style. A climate of enhanced expectations demands rapid response, and this is best handled by local managers. This will require open access to information, clear decisions, and aggressive delegation of authority.

In order to take control of its own agenda, NIST strategy calls for the use of increased funding to reduce the rate of support of laboratory programs by other Federal agencies to about 20% by Fiscal Year 1997, with no increase of laboratory staff. The NIST laboratories received a 17% appropriations increase in Fiscal Year 1995, following a 17% increase in Fiscal Year 1994. This will enable a reduction to about 25% in the rate of support by other Federal agencies during the current Fiscal Year. This will be accomplished by replacing contract research that is not strongly tied to NIST's industrial support mission with more mission-oriented, base-funded research.

In order to increase its ability to respond to industrial technology needs, in addition to its extensive participation in collaborative programs with industry, NIST intends to form long-term, strategic relationships with universities, not-for-profit laboratories, and national laboratories. It will seek opportunities to operate, support, and participate in national facilities that offer benefits to U.S. industry. To maintain its technical output at the highest quality level, NIST will upgrade and maintain its equipment and laboratory facilities at the state-of-the-art. We strongly support this strategy, which emphasizes quality and mission focus rather than staff growth.

NIST is also developing a new process for allocating direct (STRS) funding to the laboratories. The process is intended to be open and understandable by the staff, encourage participation by the staff, include program evaluation of industry needs, and contain clear, rapid paths to fund the best work and the best new ideas. The process should be responsive and provide clear feedback. Annual program reviews, held in March of each year, will emphasize priorities driven by U.S. industry needs and effectiveness measured through technical quality and industry impact. The reviews held in March 1994 were the basis for decisions on competence programs in Fiscal Year 1995, on laboratory funding, initiatives, and staffing for Fiscal Year 1996, and on possible initiative topics for strategic planning workshops for Fiscal Year 1997 programs. We also note that the former NIST Director's reserve funding has been returned to the laboratories, giving more autonomy to the individual laboratories.

Information Technology Laboratory

NIST has announced that it plans one major change to its organizational structure (shown in fig. 1), the creation of a new Information Technology Laboratory by combining its existing Computer Systems Laboratory and Computing and Applied Mathematics Laboratory. The new laboratory is intended to play a high-leverage role by focusing on the infrastructural issues of interoperability and scalability for information systems. Plans for the new laboratory and its timetable are being developed, and a director for the new laboratory is expected to be named in Fiscal Year 1995. The new director will play a central role in planning for the new laboratory and we look forward to reviewing these plans as they are developed. Such a laboratory could harness the considerable technical competence at NIST to play an important role in U.S. information technology and in the formation of the National Information Infrastructure (NII).

In discussions with several experts involved in information technology and the NII, it is clear that standards and interoperability are key issues. NIST is uniquely qualified to play a central role in these issues. It is also clear that industry does not want the government to set the standards but would welcome NIST in the role of conveyer, facilitator, neutral analyst, and producer of background studies. A recent report of the National Research Council (4) on "Realizing the Information Future" describes a concept called "NII compliance," by which is meant a set of interface standards that determine when a system or subsystem is compatible with the objective of a particular information infrastructure. NII compliance could be used to determine whether a particular fiber/coax video server system is capable of evolving into a system capable of serving the NII. We believe it is appropriate for NIST to be the facilitator, keeper, and conformance tester for NII compliance. NIST already has a strong role in conformance testing and is running user groups such as the ISDN users' group. NIST also has had success with information standards for security and privacy. We are pleased that NIST is taking the initiative to create a new laboratory for information technology and want to emphasize the importance of finding a knowledgeable, dynamic manager to lead this laboratory. The opportunity is great, and NIST has much to offer in the present environment.

Measuring Results

Since 1981, NIST has been active in developing and applying a methodology to assess the economic impact of its laboratory research programs. Nine studies (5) on separate laboratory project areas have been carried out, and two more are in progress. These studies demonstrate that NIST laboratory programs affect industry in three ways: improving the timing and efficiency of R&D, enhancing the quality and control of manufacturing processes, and reducing the costs associated with market transactions among buyers and sellers. The aggregate economic impact determined in these studies, that is, the return on taxpayers' investment in these NIST programs, has ranged from 64% to 428% per year. (The aggregate economic rate of return is identical to what economists call the "social rate of return." It is derived from the "internal rate of return" used in the finance/business management literature.) Averaged over the nine completed projects, the technology infrastructure research at NIST has a median rate of return of 167%. A recent NIST report (3) describes 17 specific examples of how the NIST laboratories are applying their unique capabilities to help U.S. industry.

Board on Assessment Report

The Board on Assessment of NIST Programs provided us with an overview of their Fiscal Year 1993 assessment of the NIST laboratory programs. Their subsequently published report (6) should be consulted for details. Concerning strategic plans in the laboratories, the Board on Assessment gave strong support to the VCAT model for strategic planning contained in our 1993 report (7), and identified the need to coordinate Division-level plans with laboratory-level plans and the need for interlaboratory coordination in planning. The Board saw the need for more emphasis on fundamental research and laboratory-based standards work as the underpinning of NIST's services. They concluded that NIST's extramural programs have had a positive impact on the laboratory programs through opportunities for external collaboration, technology transfer, and input to planning.

The Board noted the impressive array of mechanisms used by the laboratories for collaboration with industry. They pointed out that industrial products and processes are increasingly interdisciplinary, that NIST has a tradition of successful interdisciplinary R&D, but that changes in planning, funding, and rewards are needed to promote a more widespread interlaboratory culture at NIST. The Board also recommended that the NIST laboratories serve as a test-bed for the application of Total Quality Management to R&D.

We agree with these conclusions and recommendations of the Board. Since the time of the Board's laboratory visits on which their report is based (February to May, 1993) we have seen significant progress in laboratory planning and in the development of interdisciplinary R&D. New competence projects in fundamental metrology have been initiated. Quality manuals are under development in several of the measurement and calibration programs. We look forward to additional information on these issues in the next report from the Board on Assessment.

Facilities Improvements

The single most important problem for the long-term health of the NIST laboratories is the substandard condition of the physical plant (8). Laboratory design consultants conducted extensive reviews and evaluations of NIST programs and facilities and concluded that technological obsolescence of NIST's laboratories is extensive and that the overwhelming majority of laboratory space will fail to meet program requirements within the next several years. We have supported the repair and upgrade of NIST's facilities in a report (9), testimony to Congress, and meetings with senior officials at the Department of Commerce. NIST has developed a well thought-out approach to facilities improvements, with Advanced Technology Laboratories (ATLs) to be constructed at both the Gaithersburg and Boulder sites, together with renovation of some of the existing laboratories. We believe that building laboratories that will support world-class research for many years to come is the correct approach for NIST. In addition to the ATLs and the limited major renovations now underway with the Capital Improvement Facilities Plan (CIFP), NIST must find ways to address the technical obsolescence and degradation due to age of their other facilities.

Performance and design criteria for the ATLs were developed after extensive study of other world-class laboratories in the U.S. and abroad and drew heavily on discussions with the NIST research programs with the most demanding requirements. Plans call for space that is both state-of-the-art and flexible, in order to meet requirements well into the future. NIST's CIFP is now well into the design phase. The schematic designs for the Gaithersburg and Boulder ATLs have been completed and the design development phase is scheduled to be completed in April 1995.

The Advanced Technology Program

The Advanced Technology Program (ATP) was created in 1990 to invest directly in U.S. industry to develop high-risk, enabling technologies that can lead to advanced products, manufacturing processes, and services with potentially large economic benefits to the nation. It directly addresses concerns about intensified foreign competition in a global market at a time when there is reduced long-term R&D investment by industry and greatly reduced defense investment in industry. The ATP addresses these concerns by fostering the development of enabling technologies that would not be pursued, or would not be pursued in a timely manner, by private funds alone. U.S. industry must lead the preparation of technology development proposals to the ATP, must cost share, and must demonstrate a commitment to downstream commercialization. However, the ATP does not fund product development, although a number of "spin-off" products have already resulted from ATP-funded projects (2). The ATP is regarded enthusiastically by U.S. business, is supporting the development of many exciting technologies, and shows promising short-term indicators of success.

Companies funded by the ATP assert that they have been helped to accelerate technology development and commercialization by funding high-risk research and development that would not have been done otherwise or would have been done too late to capture the appropriate market. The ATP has also clearly catalyzed the formation of consortia among companies, and also among companies, university, and government laboratories which were unlikely to have occurred without the ATP. From our contacts it is clear that present competitive markets pressure companies toward taking a short-term view. However, the ATP encourages companies to take a longer-term outlook. It also stimulates them to form alliances with other companies which might not otherwise occur. ATP is open to companies of all sizes – from start-ups to major corporations. About half of the awards to date have been made to small businesses, reflecting the entrepreneurial strength in these firms. Even in the case of large companies, the ATP process stimulates entrepeneurial effors within these companies.

Program Development

In its first four years, the ATP held four general competitions open to all areas of technology. Proposals from industry are not evaluated on the basis of the specific technology proposed but rather on the quality of the proposal and on the potential economic impact. The criteria used for evaluations were:

- ☐ scientific and technical merit;
- ☐ the potential for broad-based economic benefits;
- ☐ plans for eventual commercialization of the research;
- ☐ the experience and qualifications of the proposer; and
- ☐ evidence of the proposer's level of commitment to the project, and clarity and appropriateness of the proposer's management plan.

In order to accelerate progress in key technology areas to have the maximum impact on U.S. technological competitiveness, NIST has added focused program competitions to its ongoing general competitions. We support this strategy. General competitions support innovative ideas in all areas, while focused competitions, developed with the advice of industry, support technologies with special strategic importance. The approach used by the ATP for selecting focused programs is the same as that used in project selection for the general competitions – let the ideas come from industry and select on the basis of clear evaluation criteria. The criteria used for selecting focused programs are similar to those used for project selection:

☐ potential for U.S. economic benefit;

☐ strength of the technical ideas;

☐ evidence of strong industry commitment; and

☐ the opportunity for ATP funds to make a significant difference.

ATP competitions within the focused programs will fund specific projects, using the same procedures and selection criteria used for general competitions. In developing focused programs, the ATP has involved industry through requests for "white paper" proposals, sponsorship of numerous workshops, and many individual contacts. We strongly support this strategy of selecting focused programs on the basis of ideas from industry, rather than on the basis of personal judgments.

In April 1994, the ATP announced five focused programs:

☐ *Tools for DNA Diagnostics* – a five-year, $145 million program to develop compact, low-cost, automated DNA analysis technologies and equipment to enable fast, inexpensive detection and diagnosis of human, animal, and plant diseases.

☐ *Information Infrastructure for Healthcare* – a five-year, $185 million program to develop critical information infrastructure technologies to enable enhanced, more fully integrated medical information systems across the healthcare industry, greatly reducing costs and errors in handling medical information.

☐ *Manufacturing Composite Structures* – a five-year, $160 million program to reduce the high initial costs of using advanced composite materials, traditionally found only in military and sports applications, to enable the use of these strong, lightweight, durable materials in large-scale commercial applications such as bridges and automobiles.

☐ *Component-Based Software* – a five-year, $150 million program to develop the technologies necessary to enable systematically reusable software components – small, carefully engineered software elements suitable for automated assembly in a broad array of applications.

☐ *Computer-Integrated Manufacturing for Electronics* – a five-year, $105 million program to develop a flexible, software-based framework needed to promote greater manufacturability, productivity, and product variety in the electronics industry – allowing U.S. firms to more easily scale up and reconfigure their manufacturing operations.

In December 1994, the ATP announced six additional focused programs:

☐ *Motor Vehicle Manufacturing Technology* – a five-year, $185 million program to foster innovations in manufacturing technologies that can strengthen capabilities and lead to dramatic advances along the entire automotive production chain, including more versatile equipment, better control and integration of processes, and greater operational flexibility at all levels. Automotive suppliers are expected to be key partners and players in this program.

☐ *Catalysis and Biocatalysis Technologies* – a five-year, $160 million program to develop the tools, abilities, and theoretical insight to identify, design, and implement new catalysts and processes of major economic importance to chemical producers and users.

☐ *Materials Processing for Heavy Manufacturing* – a five-year, $145 million program to develop and demonstrate innovative materials processing technologies that will help U.S. heavy manufacturing companies make longer lasting, more reliable, and more efficient products. Truck engines that need overhauls only after 1.6 million kilometers (1 million miles), drive trains that require only half as much maintenance and repair, and a 2% increase in power-generation efficiency are examples of advances that could result from research in this focused area.

☐ *Digital Data Storage* – a five-year, $125 million program will concentrate on six technical objectives: increase tape and disk storage density, develop better performing magnetic recording heads, develop new lubricants and surface finishes, develop more reliable tracking devices, improve signal-processing electronics, and significantly advance the state-of-the-art in data storage and retrieval software. By assisting industry to exploit the revolution in digital storage, the program will help American companies to expand digital storage markets and market share dramatically.

- ☐ *Digital Video in Information Systems* – a five-year $120 million program to help develop interoperable digital video capabilities for emerging information networks through techniques for encoding, converting, and transcribing video data into the various forms required by the network. The program will help U.S. firms to take commercial advantage of the information network to allow any video-based information product to travel via wire, optical fiber, satellite, or broadcast seamlessly into regular TVs and other information appliances.
- ☐ *Advanced Vapor Compression Refrigeration Systems* – a five-year, $50 million program to develop more efficient, quiet, and compact air-conditioning and refrigeration systems with the lowest achievable environmental impact. The projects selected will focus on improving the vapor compression cycle, the principle of operation for most current cooling equipment. The overall technical goals are to increase system efficiency, reduce noise levels, and reduce refrigeration components' sizes – each by 25% – and to design and manufacture a system in which no refrigerant leaks.

We believe that NIST has chosen a good mix of technologies in its first eleven focused ATP programs. However, there are additional technology areas that would be good candidates for focused programs. We support the continued ramp-up to the planned Fiscal Year 1997 level of approximately $750 million, to be able to provide a broader coverage of the nation's advanced technology needs. Even at this proposed level, the ATP will represent less than one-half of one percent of the Federal R&D budget, but we believe that it leverages industrial capability.

In October and November 1994, 56 ATP awards were announced for the first five focused program competitions, with estimated five-year funding of $224 million from the ATP and $229 million from industry. Also announced in November 1994 were 32 awards for the fifth general competition, with estimated five-year funding of $85 million from the ATP and about $100 million from industry. NIST management has done an outstanding job in getting the focused programs up and running so quickly, while continuing their exemplary efforts on the general competition, where a new high of about 400 full proposals was received and evaluated.

The ATP tried a new approach to the general competition this year by asking for the submission of abbreviated proposals. Almost 1000 such proposals were received and evaluated, and of these, 83 were encouraged to submit full proposals. However, the experiment was not judged to be fully successful because, despite its best intent, still almost 400 full proposals were received. The ATP has decided not to use the abbreviated proposals procedure in the next general competition.

Measuring Results

The ATP is continuing a set of surveys and analyses on the overall short-term impacts of the program as well as on individual projects. The 1993 Solomon Report (10) surveyed the short-term impacts of ATP awards. Based on a survey of the winners, the most important effects were: the ATP provided the ability to afford the research, that is, the work would not have been done without ATP support or would have been done dramatically differently; the industries gained great benefits from industry-to-industry collaborations that probably would not have taken place without the ATP stimulus; and the winners gained in credibility among their peers – the so-called "halo" effect. A more extensive study, the Silber Survey, is due out in early 1995.

Two analyses on specific projects were conducted. The 1993 study of the Printed Wiring Board Joint Venture (11) demonstrated a savings of over $20 million in research costs and productivity gains averaging 30%. The recipients also considered that they were behind foreign competition at the beginning of the project and close to parity after two years. Similar results were obtained in the 1994 study on the Joint Venture Project on Short-Wavelength Sources for Optical Recording (12). Two additional studies are underway with reports due in 1995. A recently issued NIST report (2) gives many examples of the ways in which ATP awards are making a real difference in industry.

The Manufacturing Extension Partnership

The Manufacturing Extension Partnership is now building rapidly on its solid success with seven extension centers in Fiscal Year 1993 increasing to 35 extension centers in Fiscal Year 1994, with 28 of the centers funded by the Technology Reinvestment Program and managed by MEP. Small companies have come to value the extension centers for expert advice and help. Companies working with the original seven NIST centers through September 30, 1993 estimated collective benefits of $320 million – achieved with a Federal investment of $54 million. A first quarter evaluation of the seven centers showed 2,511 activities serving 1,613 companies. Client evaluation surveys of 199 completed projects, from a total of 632 ongoing projects, estimated total benefits of about $50 million with 620 jobs saved or created. Each center was created through a competitive process which evaluated the proposers' knowledge of small and medium-sized businesses in the proposed region, their ability to link all of the technology resources of the region, and their capability to deliver technology services. Adaptability to local and regional needs is a major source of the program's strength.

We were briefed on the operations of the Great Lakes Manufacturing Technology Center (GLMTC) by its Director. This center is well-connected to the many technology resources in its area. Since its founding in 1989, it has made over 7000 initial company contacts and over 1900 first-time plant visits. It has provided over 3000 instances of technical assistance and over 150 technical assessments. The potential annual cost savings to companies are estimated to be over $200 million. The GLMTC illustrates very well the value of manufacturing extension centers.

Building a National Manufacturing Network

We noted in last year's Annual Report (13) that the MEP had proposed a well thought-out and aggressive plan to develop a national-level manufacturing support network. Recognizing the potential of such a network to help the nation's smaller manufacturers adopt and apply performance-enhancing technologies, the Administration set the goal of creating a nationwide network of 100 extension centers by 1997. Subsequent actions by the Congress, including a 66% budget increase in Fiscal Year 1994, and a 200% budget increase in Fiscal Year 1995, make it seem possible to realize this goal. As we stated last year, the Federal Government would be hard-pressed to find a better investment to improve the technological know-how and performance of the nation's small manufacturers.

The changes necessary for the MEP to become a coordinated national manufacturing network (14) are well underway. Legislation is in place which allows the MEP to fund up to one-third of the operating costs of the three oldest manufacturing centers for a seventh year, contingent on continued satisfactory performance. MEP's experience indicates that revenue generated by the centers will not be sufficient to cover the costs of providing services to smaller manufacturers. To enable continued focus on meeting the needs of small manufacturers, we recommend Federal support beyond the sixth year of operation. The MEP will perform sixth-year evaluations of three centers during Fiscal Year 1995, together with third-year evaluations of two centers as required by law. Efforts are underway to develop a larger pool of competent applicants. We support these efforts, with the understanding that applicants continue to meet the selection criteria and that MEP conduct regular, thorough evaluations of ongoing centers.

The MEP and the Technology Reinvestment Program

Of the 35 present manufacturing extension centers, 28 are funded by the Technology Reinvestment Program (TRP) and managed by the MEP. The MEP

NIST Manufacturing Extension Centers and (STEP) Projects

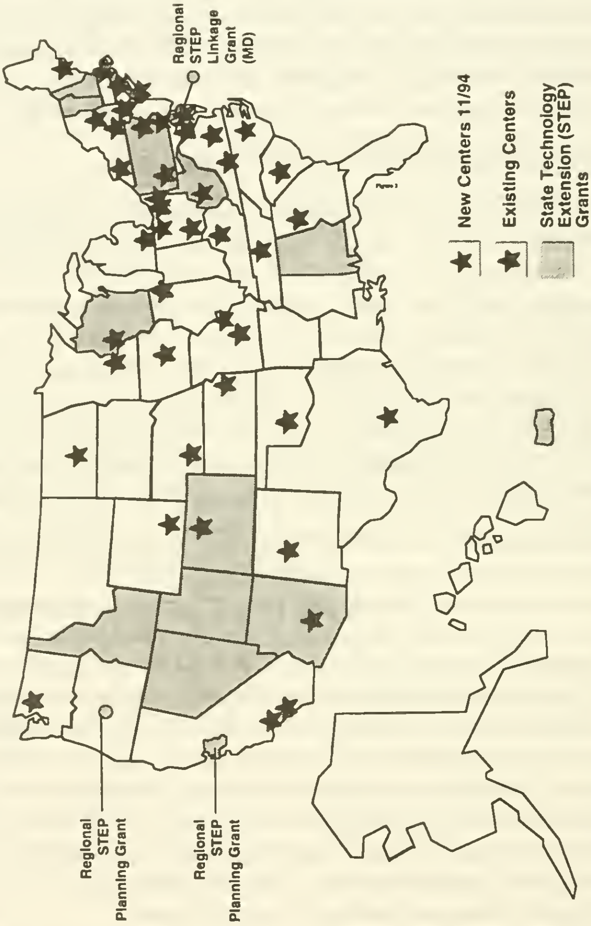
Regional STEP Linkage Grant (MD)
Regional STEP Planning Grant
Regional STEP Planning Grant
★ New Centers 11/94
★ Existing Centers
▨ State Technology Extension (STEP) Grants

Figure 2

also manages 23 additional technology development projects for the TRP with a total funding of about $38 million. The TRP thus provides financial resources which enable the MEP to expand and in addition help it to link up with thousands of companies that must convert from defense to civilian markets. The MEP plans to increase to 80 extension centers in Fiscal Year 1995. Of these, 42 centers will be developed and funded by the MEP, one center will be rolled over from TRP to MEP support, and 37 centers will be funded by the TRP and managed by the MEP. Nine new TRP-funded centers were recently announced, bringing the current number of centers either in operation or announced to 44. A list of the current centers is contained in Appendix B, and their locations are indicated on Figure 2.

We believe that the MEP's experience in working with small companies has been very valuable in getting TRP technology deployment activities underway quickly. At the same time, we are concerned by the challenge of increasing the number of extension centers from 35 to 80 in one year, while maintaining the high level of management attention which is required to assure the centers' quality of operations and services to customers. To meet this challenge, the MEP plans to hire, train, and deploy 25 new staff members and implement a pilot program to eventually train 1000 field agents.

The State Technology Extension Program

The State Technology Extension Program (STEP) works with states to develop coordinated manufacturing extension and modernization programs to serve the competitive needs of small and medium-sized businesses. The program provides support for states to build their own infrastructure for technology outreach services by planning extension systems or technical assistance programs, by supporting the initial implementation of such programs in sparsely populated regions, and by developing links between existing programs and those in other regions. The grantee is generally required to put up at least 50% of the cost of the project. Nearly $2 million has been awarded recently to Alabama, Arizona, California, Colorado, Idaho, Nevada, New Hampshire, Puerto Rico, Rhode Island, Utah, Vermont, West Virginia, and Wisconsin, as well as to regional efforts in Maryland and Oregon. We view this as a very good way to improve the access of small businesses to extension programs.

Measuring Results

The MEP has a number of ongoing activities that track or estimate impacts on the performance of small manufacturers from engagements with extension centers. In addition, the MEP is initiating further studies, with varying time horizons, that are intended to supplement the current data and track impacts over longer terms.

Preliminary results of one center's Client Progress Survey show, for example: sales, +13%; scrap rate, −29%; exports, +47%; employment, +6%; and computer usage, +46%. We believe that these data, together with other data cited above, are evidence of the value of the MEP. In addition, a recent NIST report (5) discusses six specific examples of how the manufacturing extension centers are helping U.S. industry to improve productivity, implement process controls, and develop improved products.

The Malcolm Baldrige National Quality Award Program

The Malcolm Baldrige National Quality Award has increased enormously the understanding and application of quality principles in this country. In doing so, it has become a national institution and a rallying point for quality improvement. Since 1988, 22 companies have won the Baldrige Award. Over one million copies of the award criteria have been distributed. An annual conference at which award winners present details of their quality improvement strategies and results has been established. Award winners have shared information with hundreds of thousands of companies, educational institutions, government agencies, health care agencies, and others. The award has thus had an impact which reaches far beyond the award winners.

The program is now gearing up to address new challenges. In the last budget submission, the program proposed to work with the education and health care industries to enhance their quality performance, conduct research and disseminate information on quality management strategies, and build on the worldwide reputation of the Baldrige award to enhance the quality image of U.S. exports. We supported all of these proposals; however, the only increase in funding received was for a pilot program to formulate a set of Baldrige-like criteria in education and health care. We encourage NIST to reapply for funding to support the other initiatives.

Revised Baldrige Award Criteria

In each of the last three years, applications for the Baldrige award have declined. This is not entirely unexpected, as many companies come to understand what it requires to be world-class performers. We support the rigorous standards that make the Baldrige award the pinnacle of quality achievement in the United States. At the same time, we are pleased that NIST has streamlined and changed the Baldrige award criteria for 1995 to focus more sharply on quality as an integral part of today's performance management practice. The number of criteria has been reduced from 28 to 24; the number of areas to be addressed has been reduced from 91 to 54; and the application page limit has been reduced from 85 to 70. The criteria are now a set of basic, interrelated, results-oriented requirements, focusing on seven key areas of business performance: customer satisfaction and retention; market share and new market development; product and service quality; financial indicators, productivity, operational effectiveness and responsiveness; human resource performance and development; supplier performance and development; and public responsibility and corporate citizenship. The criteria are described clearly in an attractive, well-written brochure (15).

Measuring Results

The Quality Office is attempting to assess the importance of quality in the overall performance of companies. One such study sought to assess the performance of the publicly traded stock of the winners of and applicants for the Baldrige Quality Award versus the S&P 500. The study period was from 1988 to 1993. The comparison revealed that winners outperformed the index by a ratio of 3:1 and that the site-visited applicants outperformed the index by 2:1. According to an article in *Business Week* (16), the three publicly traded whole company Baldrige winners outperformed the S&P 500 from the time they won through September 30, 1993 by a factor of 8.6 to 1. In addition, a recent NIST report (3) discusses seven specific examples of how following the Baldrige criteria has increased productivity, sales, and employment. These results show clearly the effect of emphasizing quality in maintaining consistent growth.

TOPICS FOR STUDY - 1995

In 1995 we will focus on what we believe are critical issues in each of NIST's major program areas. Many of these issues arose from our discussions with NIST senior management this year. We will revisit the strategic plans of the NIST laboratories to view how the laboratories define and prioritize their technical programs in supporting industry, and examine how their research portfolios are managed from a strategic standpoint. In the Advanced Technology Program, a key issue is how well NIST is able to build nationally significant programs in strategically important technologies through the focused programs. We will review the ATP's technical and commercial progress and their management of a growing number of diverse programs. Having established a large number of new manufacturing technology centers, the majority with support from the Technology Reinvestment Program, the Manufacturing Extension Partnership is now starting up a large number of new centers and other activities under NIST support and coordinating a national manufacturing support network. We will assess the MEP's progress on this formidable task. We will review the Malcolm Baldrige National Quality Award Program's streamlined Baldrige criteria and their pilot set of Baldrige-like criteria for health care and education. We will assess progress on NIST's Capital Improvement Facilities Program as it enters the construction phase.

REFERENCES

1. The Visiting Committee on Advanced Technology, *1993 Annual Report*, January 1994, p. 2.
2. National Institute of Standards and Technology, *Setting Priorities and Measuring Results at the National Institute of Standards and Technology*, January 1994.
3. National Institute of Standards and Technology, *NIST Industrial Impacts – A Sampling of Successful Partnerships*, 1994.
4. National Research Council, *Realizing the Information Future*, 1994.
5. The 11 economic impact studies are available from the NIST Program Office. A manual for NIST laboratory managers is in preparation which will summarize these studies and provide general guidance for participation in future studies.
6. *An Assessment of the National Institute of Standards and Technology Programs: Fiscal Year 1993*, National Academy Press, Washington, D.C., 1994.
7. See ref. 1, p. 5.
8. See ref. 1, p. vii.
9. The Visiting Committee on Advanced Technology, *Repair and Upgrade of Facilities at the National Institute of Standards and Technology*, July 1990.
10. Solomon Associates, *The Advanced Technology Program, An Assessment of Short-Term Impacts: First Competition Participants*, National Institute of Standards and Technology, February 1993.
11. A.N. Link, *Advanced Technology Program: Economic Study of the Printed Wiring Board Joint Venture After Two Years*, National Institute of Standards and Technology, April 1993.
12. A.N. Link, *Advanced Technology Program: Economic Study of the Joint Venture Project on Short-Wavelength Sources for Optical Recording After Three Years of a Five-Year Research Program*, National Institute of Standards and Technology, March 1994.
13. See ref. 1, p. 18.
14. See ref. 1, pp. 18-19.
15. National Institute of Standards and Technology, *Malcolm Baldrige National Quality Award 1995 Award Criteria.*
16. *Business Week*, October 18, 1993.

APPENDIX A
Summary of Visiting Committee on Advanced Technology Activities, 1994

Reports and Statements*

☐ *1993 Annual Report of the Visiting Committee on Advanced Technology (January 1994)*

* Copies of all reports are available from the Executive Director of the Visiting Committee on Advanced Technology, National Institute of Standards and Technology, Gaithersburg, MD 20899.

Special Meetings

☐ Meeting with Secretary of Commerce Ronald H. Brown and other Department of Commerce officials on January 4, 1994, to discuss the Visiting Committee's 1993 Annual Report and NIST issues.

Congressional Testimony

☐ Testimony at Hearing on the National Competitiveness Act of 1994, authorizing funding for the Department of Commerce Technology Administration and NIST, House Subcommittee on Technology, Environment, and Aviation of the House Committee on Science, Space, and Technology, March 10, 1994, by William G. Howard, Jr., Immediate Past Chairman.

Quarterly Business Meetings

Meeting Dates

March 8-9	September 13-14
June 8-9 (Boulder)	December 6-7

Principal Meeting Topics

- ☐ NIST and Operating Unit Strategic Planning (3/94, 6/94, 9/94, 12/94)
- ☐ NIST Budget Issues (3/94, 6/94, 9/94, 12/94)
- ☐ The Advanced Technology Program (3/94, 6/94, 9/94, 12/94)
- ☐ The Manufacturing Extension Partnership (9/94)
- ☐ Capital Improvements Facilities Program (3/94)
- ☐ Boulder Issues and Facilities Improvements (6/94)
- ☐ The Malcolm Baldrige National Quality Award Program (3/94)

Laboratory Tours and Presentations

- ☐ Integrated Services Digital Network (ISDN) Technology
- ☐ Seismically Resistant, Precast Concrete Structures
- ☐ Optical Fiber Geometry Standards
- ☐ Pulsed-Tube Refrigerators
- ☐ Research Reactor and Cold Neutron Research Facility
- ☐ Laser Cooled and Trapped Atom Group

APPENDIX B
Manufacturing Extension Centers

Listed alphabetically by lead state.
(MAMTC stands for Mid-America Manufacturing Technology Center)

Arizona Applied Manufacturing Center

California Manufacturing Technology Center (CMTC)

Pollution Prevention Center (California)

MAMTC Colorado Regional Office

Connecticut State Technology Extension Program

Delaware Manufacturing Alliance

Georgia Manufacturing Extension Alliance

Chicago Manufacturing Technology Extension Center

Iowa Manufacturing Technology Center (Iowa MTC)

Mid-America Manufacturing Technology Center (MAMTC) (Kansas)

Kentucky Technology Service

Manufacturing Modernization Program for the State of Maine

Maryland Manufacturing Modernization Network

Massachusetts Manufacturing Partnership (MMP)

Midwest Manufacturing Technology Center (MMTC) (Michigan)

Upper Midwest Manufacturing Technology Center (UMMTC) (Minnesota)

MAMTC St. Louis Regional Office

MAMTC Southern Missouri Regional Office

Nebraska Industrial Competitiveness Service (NICS)

New Mexico Manufacturing Extension Program

New York Manufacturing Extension Partnership (New York MEP)

Hudson Valley Manufacturing Outreach Center (New York)

Manufacturing Outreach Center of New York – Southern Tier

New York City Manufacturing Outreach Center

Western New York Manufacturing Outreach Center

Manufacturing Extension Program for North Carolina

Manufacturing Extension Center in North Dakota

Great Lakes Manufacturing Technology Center (GLMTC) (Ohio)

Miami Valley Manufacturing Extension Center (Ohio)

Northwest Ohio Manufacturing Extension Center

Plastics Technology Deployment Center (PTDC) (Ohio)

Oklahoma Industrial Extension System

Manufacturing Extension Partnership of North/East Pennsylvania

Southeastern Pennsylvania Manufacturing Extension Partnership

Southwestern Pennsylvania Industrial Resource Center

Southeast Manufacturing Technology Center (SMTC) (South Carolina)

Tennessee Manufacturing Extension Partnership

Texas Manufacturing Assistance Center

A.L. Philpott Manufacturing Center (Virginia)

Virginia Alliance for Manufacturing Competitiveness (VAMC)

Washington Alliance for Manufacturing

West Virginia Partnership for Industrial Modernization

Northwest Wisconsin Manufacturing Outreach Center

MAMTC Regional Office (Wyoming)

CONGRESSIONAL QUESTIONS AND ANSWERS

Dr. Mary Good
Undersecretary for Technology
U. S. Department of Commerce

and

Dr. Arati Prabhakar
Director
National Institute for Standards and Technology

Questions from Congressman Tanner

1. NIST is requesting substantial increases for FY96. I have heard concerns that these increases reflect a business as usual attitutde, with no concern for deficit reduction or making hard decisions. Can you discuss how budget decisions for NIST were made? A lot of attention has focussed on the increase to the ATP and MEP programs at NSIT, how much has funidng increased for the core programs at NIST during the last 5 years?

Answer: The NIST ATP, MEP and laboratory programs are all responding to immediate, urgent needs of U.S. industry. They address gaps in U.S. competitive position that have developed in recent years because of the changing character of the global marketplace and because of rapidly evolving technologies. These gaps will widen rapidly if they are not addressed with urgency, and all of our competitors are dealing with these gaps. Budget decisions at NIST are strongly influenced by this situation.

The ATP was conceived as a national program, dedicated to the development of early-stage, precompetitive civilian technologies to fuel economic growth. We judge that at the $750 million level, ATP will be a national program and can be expected to have national-scale impacts. To date, the ATP has received and processed many more worthwhile proposals than it has been able to fund. These proposals cover a diverse cross-section of enabling technologies that affect a variety of industries. Funding below the $750 million level means that important areas of high-risk, pre-competitive technologies will have to be left out of the ATP process.

The MEP is also designed to grow to become a national program. We judge that at the 100-center level, most of the nation's 370,000 smaller manufacturers will be within practical reach of an extension center. The original seven manufacturing centers were established and are funded through the NIST budget, the newer 37 manufacturing extension centers were funded through the Department of Defense's Technology Reinvestment Program (TRP) budget and managed by the NIST MEP. Beginning in FY95 the TRP-funded centers have begun rolling over from the TRP funding to NIST funding. Further rollovers are reflected in the FY96 NIST budget request.

Budget decisions in the NIST laboratories are made as the result of extensive evaluations by NIST managers of the areas in which NIST can best and uniquely supply infrastructure for technologies that have emerged as keys to competitiveness. Needs in areas such as metrology for semiconductor manufacturing, biotechnology, and support for standards information and assistance, have been identified in extensive planning exercises that the labs undertake with industry. Such new technical activities will strengthen the NIST laboratories' core capabilities, which have been confronting the rapidly evolving technology trends during a decades-long period of flat budgets. This situation has improved over the last five years with an average 13.3% per year increase in base funding for the NIST core laboratory programs. Demands from industry are still challenging NIST's present capability, and hard decisions concerning prioritization of new projects and rollover of existing projects are continually being made.

2. The ATP and MEP programs have been criticized as being bureaucratic and managed by people who don't understand business. How much has NIST employment increased as a result of the significant increases in the ATP and MEP programs? What are the backgrounds of the people who run these programs?

Answer: ATP - The Advanced Technology Program (ATP) has grown with the increase in funding. In FY 1993, the ATP had only 18 FTE growing to 31 FTE in FY 1994 and a projected growth to 58 FTE in FY 1995. Even with this increase in personnel, the ATP is a very lean organization considering the size of its budget. In addition to direct program growth, NIST has added 4 positions in administrative support services, such as grant processing, facilities services, etc.

The ATP carefully considers the background and experience of its staff. During the last two years, the majority of people hired have been from outside the government, many with years of experience in diverse industrial settings. Program managers usually have advanced degrees in science or engineering, management experience, and first-hand experience and knowledge of technical issues facing one or more industrial sectors. The ATP has a wide variety of science/engineering disciplines represented including biotechnology, electronics, software development, materials, and information technologies.

The ATP also has an economic assessment staff who deal with the business issues of the ATP. This staff is composed of personnel with advanced degrees in economics, business administration, technology management and/or law. Additional science or engineering degrees are also desirable, which many of our staff have. Beyond advanced degrees, the staff is required to have experience in areas such as microeconomic research, business planning, intellectual property management, business law and/or international trade.

MEP - In FY 1994 there were 33 FTEs supporting the MEP. In FY 1995, MEP is projecting 60 FTEs. There are no NIST employees in the field staffing any of the 44 NIST MEP manufacturing extension centers. These centers are staffed by experts who are tuned into the needs of the local manufacturers. In addition, to direct program growth, NIST has added 3 positions in administrative support services, such as grants processing, facilities services, etc.

The MEP staff members have extensive experience in the various capabilities needed to support technology and business extension to industry. Many have extensive experience in the private sector, state government, or academic institutions and have advanced degrees in areas such as manufacturing, engineering, senior level management and international management, information technology, finance, and state industrial development. Additional staff experience includes: developing and implementing outreach, supplier development, and information technology assistance programs for small manufacturers; conducting industry studies and developing evaluation plans; long-term ownership and/or management of successful small, private companies as well as international companies.

MEP centers across the country are staffed by professionals who have hands-on manufacturing experience. While some of these staff specialize in certain technologies or modern manufacturing techniques, the majority have broad manufacturing experience gained on the shop floor, from funding a small firm, or from other manufacturing industry positions. Staff are employed by the non-profit manufacturing extension centers, and are not federal government employees.

3. Has the rapid increase in the ATP and MEP programs distracted NIST from its original mission? Have there been any spin-off benefits to the core programs from the ATP and MEP programs?

ANSWER: The rapid increase in the ATP and MEP programs has not distracted NIST from its original mission, and has in fact aided the core laboratory programs in several ways. First, during the period that the ATP and MEP have grown, the NIST laboratory budget has also grown, averaging a yearly 13.3% increase in funding for the NIST laboratories over the last five years.

With regard to spin-off benefits for the laboratories' core programs, there have been several for the ATP, and we expect that developing synergy with the MEP will also enhance performance of the laboratories' mission.

The ATP has provided a valuable window for the NIST laboratories into the present and future technological infrastructure needs of U.S. industry, as well as industry's perspective on how technology development is coupled to commercialization issues and economic impact. Examples related to the laboratories interactions with ATP awardees include new core laboratory programs on standards for flat panel displays, measurement methods using neutrons and x-rays, and research in the characterization and control of a new class of machine tools.

The relationships between the labs and the MEP are still being developed, but we expect the MEP to help the NIST labs improve linkages and outreach to smaller manufacturers, enhancing the NIST labs ability to understand the needs of those manufacturers and to work with them on solutions.

4. Why is it important to have a Technology Administration and could you explain what are the functions of the Office of Technology Policy?

ANSWER: Private sector innovation, along with expanded markets for U.S. exports, a skilled and flexible work force, and a sound climate for private investment are the four pillars supporting sustained economic growth and opportunity -- and are the basis of the Administration's economic policy. Although many federal departments are working toward strengthening one or more of these pillars, the Technology Administration is the *only* federal agency whose *sole* mission is to assess and support the civilian technology base and U.S. industry's technological competitiveness.

The importance of this mission is illustrated by a vast body of respectable economic research. For example, a study completed by Boskin and Lau in 1992 attributes roughly 50 percent of the nation's productivity growth since World War II to technology. In addition, policy makers from both parties have recognized for more than ten years that government policies to strengthen industry's technological competitiveness are needed in response to the imperative of the new global economy. The President's Commission on Industrial Competitiveness concluded in its 1985 Report to the President:

> "Technological innovation, fueled by research and development, is a major force for improving the nation's productivity, industrial competitiveness and economic growth. *It should be U.S. policy to strengthen our science and technology base and its application toward enhancing the technological capabilities of U.S. industry...* . [Every] responsible approach should be pursued toward advancing R&D relevant to industrial processes and production, and bringing them to bear on the improvement of U.S. manufacturing."

With the end of the Cold War, and the rise of even more able foreign competitors during the last ten years, it has never been more important that American businesses and workers are able to compete by producing the highest quality goods and services at the lowest possible cost. As a result, TA's responsibilities for promoting civilian technology have never been more critical to our country's economic future.

TA includes the National Institute of Standards and Technology (NIST), with its extensive laboratory operations and its extra mural programs in Manufacturing Extension, Advanced Technology and Quality recognition and promotion.

TA also includes the National Technical Information Service (NTIS), which provides the data banks for the government's vast collections of science and technology documents; NTIS's FedWorld, an on-line information system, has led a revolution in the dissemination of government-collected information--including technical and business information from around the world--to a wide audience of customers.

The third component of TA is the Office of Technology Policy, which is the policy making arm of the Technology Administration. It is staffed by a small but talented and dedicated group of professionals led by Assistant Secretary Dr. Graham R. Mitchell. OTP is the *only* office within the federal government that has as its *only* mission working in partnership with the private sector to develop and advocate federal policies to maximize the impact of technology on industrial competitiveness and the nation's economic growth.

With a focus on the industry as its customer, OTP's work addresses the broad range of issues that affect U.S. companies' ability to develop technology, turn it into products and services, and bring them to global markets at a rapid pace. OTP is responsible for several congressionally-mandated activities in the international technology area, including the U.S.-Japan Program and several of the U.S. science and technology bilateral agreements.

OTP also provides the key factual analyses needed to make policy decisions for the government's civilian technology programs and to assess the technology position of our industries and the country as a whole. For example, OTP will publish in the next several weeks an assessment of the composition, geographical distribution and strengths and weakness of the U.S. manufacturing sector. This information is vital to a reasoned debate regarding the technology needs of American manufacturers, and to fashioning appropriate policy solutions.

OTP will also provide within the next two months a Congressionally-mandated report on federal technology partnerships. This document is in response to the Stevenson-Wydler Act requirement to comment on and analyze the effectiveness of the technology transfer activities of the Executive Branch. This report will provide federal policy makers information regarding which partnership models are working, and which can be improved, as well as provide guidance for crafting future government-industry technology partnerships.

During fiscal year 1995, OTP will release competitiveness assessments for several industries, including biotechnology, international construction, automotive, financial services. These reports, prepared by OTP in conjunction with other Commerce agencies and private sector input, will assess the technology position of each industry, as well as the key non-technical factors which impact the ability of each industry to compete in global markets. These reports will identify critical policy issues which cut across several industries, and which may require policy changes.

In addition, OTP, together with the Office of the Under Secretary, works to ensure that the Commerce Department's customers have an aggressive advocate in the development and coordination of Administration-wide technology efforts, and that these policies and programs expand economic opportunity for all Americans.

Attached are two documents, the OTP Brochure, and Highlights of US/OTP activities, which provide an overview of all major OTP activities. The "Highlights" document also indicates which of those activities are congressionally mandated.

5. ATP claims its central purpose is to promote economic growth in the U.S. by helping companies develop high-risk technologies. What steps have you taken and what standards have you put in place to measure the benefits of this program? How has the program changed since its start? What prompted these changes?

Answer: ATP has placed a high premium on evaluation of its programs <u>from the very start</u>.

Our evaluation process has five elements: assessing ATP's own critical operational activities; `portfolio' profiles of applicants, recipients, technologies, and projects; evaluation of industry's implementation of both the R&D and business components of ATP projects; tracking short-term and intermediate project results; and measurement of long-term economic impacts.

What we focus on is the last category: long-term economic impacts. The primary goal of the ATP, and the real payoff, is the economic growth in the future that will come from the introduction of new products and industrial processes based on ATP-supported R&D.

But because the ATP invests only in pre-product technology development, because it is still a very modest program in terms of the larger R&D enterprise, and because nearly all of the projects it funds are still in the research phase, no one should expect to see major impacts on the economy this soon.

However, we have been tracking some early indicators that the projects are on course and the economic potential is building.

- <u>Encouraging high-risk R&D.</u> The ATP has been successful in attracting relatively high-risk R&D projects that otherwise would not be attempted.
- <u>Promoting research efficiencies and reduced time-to-market.</u> The joint ventures and alliances fostered by the ATP are reporting significant research efficiencies and early use of research results.
- <u>Progress on commercialization.</u> The results of ATP R&D projects are being incorporated into

competition requires a focus on providing high quality, competitively priced products with quick delivery to market and lower margins. The current product life cycle requires the renewal of products or the replacement of products by new ones on a much faster time scale than our old, linear research-to-product development model would allow. For example, in the electronic industry the lifetime of a new model of personal computer is less than two years. Our industries can no longer afford to invest in long-term enabling and emerging technologies, they can no longer afford to invest in a broad technology pool (which provided technology for themselves, but also spilled over for the good of the country and the world at large).

7. Your request for FY96 funding for the MEP includes funding for Centers currently supported under the TRP. How many Centers does your FY96 budget request support? How much of the budget request will go to support new Centers?

Answer: The FY 1996 budget request for the MEP will support 90 Centers. $14 million has been allocated to new Center funding for FY 1996, an additional 10 Centers are anticipated.

8. What is the purpose of the budget increase for the Malcolm Baldrige Quality Award?

Answer: To initiate the transformation of the Malcolm Baldrige National Quality Award Effort into a National Quality program, the Fiscal Year 1996 request will allow research on successful quality improvement/business competitiveness strategies to be conducted in cooperation with universities and industry. Establishment of a National Quality Program at NIST will permit collaborative research and outreach services to further the dissemination of information to U.S. businesses on initiating and sustaining a quality management effort. A major focus will be placed on information for small and medium-sized businesses. At a recent Conference Board meeting for corporate executives and senior managers, a written comment from an attendee summarizes expectations. "I would suggest the [NIST] Quality Research segment...as the most urgently needed future development for Corporate America. We need qualified people identified who really understand the Baldrige criteria to assess and improve their operations." The proposed transition from an "award program" to a Quality Program would place at NIST the capabilities to better serve U.S. industry's infrastructure needs in understanding the components of a business excellence program and how to begin the effort.

9. There has been criticism that the ATP program is nothing more than bureaucrats picking winners and losers? How are ATP awards given? How does NIST select areas of research focus?

Answer: ATP is industry-oriented. While government provides the catalyst -- and in many cases, critical technical support -- industry conceives, manages, and executes each ATP project. Industry proposals are based on the private sector's understanding of market trends and future opportunities. All projects are selected on the basis of both technical and business merit through a fair and rigorous competition that draws on both government and private sector expert reviewers.

We get our ideas for research focus from industry. Through a series of public meetings with industry, NIST found widespread support for the idea that focused programs could help maximize the ATP’s leverage by driving key strategic technology areas. Industry has demonstrated its strong support for this concept by submitting nearly 900 ideas for focused ATP program areas. And we have had several thousand industry representatives taking part in our ATP workshops. Those sessions have tremendous value, not just in helping to plan our program, but in convening different segments of industry to discuss mutual goals and interests.

we believe that, in one sense, “picking winners and losers” is the old way of setting federal R&D priorities. The federal government long ago picked agriculture, aeronautics, space, energy and health. The whole point of the ATP is to maximize economic impact by letting industry’s ideas -- backed up by their financial commitment -- determine what is funded. That is the new concept in federal R&D that is embodied in the ATP.

Suggesting that programs like the ATP pick winners and losers also underrates the tremendous efforts of our industries. Consider what it really takes for a company to make a winner in the market: product development, manufacturing and production, global marketing and sales, distribution and service systems. All of these jobs belong to industry, and ATP is doing none of them. ATP’s job is to cost-share the high-risk, enabling R&D that is upstream of product development, creating new opportunities for companies to pursue.

The acid test is simple: ask any ATP participant what it will take to launch a successful product in the marketplace beyond the work being performed with government-provided funding. Their own investments will always be substantially larger that the government's relatively small cost-shared funding. And that added investment comes not from the ATP, but from the private sector.

10. I have heard concerns that the MEP program is telling small manufacturers and entrepreneurs how to run their business -- something they know how to do better than Washington bureaucrats. How do you answer these concerns?

Answer: The MEP relies on existing state and local industrial extension resources to assist manufacturers in assessing their manufacturing and business operations. The extension center field agent that works with the small manufacturers is not a bureaucrat from Washington, but is locally based and typically has 10 to 15 years of manufacturing experience. The extension center field agent provides third-party unbiased advice which the manufacturer can use to make decisions for themselves. The intent is to help the small manufacturer understand the alternatives so that they can make their own decisions.

CONGRESSIONAL QUESTIONS AND ANSWERS

Dwight Carlson, President
Perceptron, Inc.

Questions for Conner, Caisse, Carlson, Gibson, and Singer

1.a. Providing a capital gains tax cut would certainly be appreciated by entrepreneurs like me but it would be completely unrelated to stimulating industrial research and development. A company like Perceptron allocates 10-13 percent of its sales to development and requires funding for research to come from other sources.

1.b. We have first-hand experience with federal dollars concentrated on basic research through the National Science Foundation. We believe supporting this basic research through universities is a sound, strategic investment and is administered by the National Science Foundation in a professional manner. We would not recommend making changes to the current National Science Foundation program.

1.c. We are in the third year of an ATP program called the 2mm Program. Our first-hand experience shows that the government involvement in development and deployment of commercializing technology is an unqualified success. The administration of the program by NIST has proven to be the key to this success. We highly recommend and encourage Congress to enthusiastically support NIST and the ATP program.

1.d. The biggest threat to the quality of life in America is in industrial competitiveness. As a nation, we must recognize this priority and make investments to coincide with this reality.

2. A permanent research and development tax credit and a reduction in capital gains would be appreciated by entrepreneurs like me but it would be of little benefit in stimulating our research activities. In addition, I seriously doubt that it would stimulate additional research and development dollars in Fortune 500 companies.

3. I do not believe that, other than the government, there is any other segment of American society making strategic, long-term investments for the good of the nation. In return for the NIST ATP, we have seen increased competitiveness, creation of new jobs, and increased tax revenues for the federal government. This is not corporate welfare.

4. The unique characteristics of the ATP program are: a) grants are made directly to companies; b) a majority of ATP grants have been made to smaller companies to enable them to team with university researchers; c) the NIST ATP program provides research dollars for manufacturing; the NIST ATP gives expert guidance and advice.

   I have a long-standing relationship with the venture capital industry in America and recognize that industrial technology does not qualify for venture capital investment because the time from research to commercialization exceeds the standard ten-year venture capital limited partnerships.

Questions for Dwight Carlson

1.a. It is very important that NIST be involved in the ATP program because they provide the experience and knowledge to ensure the success of the program.

1.b. NIST involvement did add credibility with the participating companies.

1.c. Yes, we currently have two CRADA's with NIST providing research to solve specific technology problems.

1.d. The NIST ATP program is unique from any other government program that I am aware of.

CONGRESSIONAL QUESTIONS AND ANSWERS

Mr. David B. Singer
AAFYMETRIX

1. I can only answer this question in the context of the type of entrepreneurial industry in which I am involved. This industry is on the cutting edge of its technology, a technology that is complicated and not widely understood by even the venture capital experts. We are small and we compete with many other small and relatively new companies. Let me address the four elements of your scenario of changes as they would effect my current efforts that have received funding under the ATP.

First, providing capital gains tax cuts would not necessarily have any benefit for our type of pre-competitive research, which can span somewhere between five and ten years. Investors interested in a capital gains tax cut are looking for an investment they can turn around quickly, not one that has to be held for at least five years. While easing regulations may cut some of our research costs, it would not drastically alter the balance between internal funding for product development and research.

Second, concentration of Federal dollars on basic research would be helpful; much of today's high technology industries are benefitting from federally funded research during the 1950s and 1960s. But, it is equally important to recognize that the dynamics of capital investment in those years differs dramatically from today. Then, companies were willing to spend pre-competitive research dollars that might not result in commercial products in the near term and might take ten years to develop. Today, they are not able to have that luxury; they are focused on short-term returns. Foreign competition and investment horizons intensify this problem.

Third, while I cannot speak to all of the government technology research efforts, I can say unequivocally that the ATP is not developing commercial technologies. Rather, it is providing assistance during the pre-competitive development stage of emerging technologies. This phase of research falls after basic research and before commercial development. It can take ten years and even venture capitalists will not invest in research with that long of a return time. However, without assistance much of the pre-competitive work will be done outside of the United States. To get the government out of ATP would only give the ultimate advantage to our foreign competitors. As I have said in my testimony, if we don't support this type of research, some other country will. Rather than being viewed as a program using federal dollars where private dollars would otherwise be spent, it is important to recognize that the presence of the federal dollars provides the opportunity for private dollars to be spent. Under the ATP the tough competition to get a grant demonstrates to the private sector that the technology has possibilities and encourages the private dollars to move to these higher risk research efforts.

Fourth, streamlining procurement policies sounds useful, but it has no effect on whether or not pre-competitive work is completed. Procurement policies do not have a part in this early stage of research prior to commercial development.

2. Replacing ATP, SEMATECH and all similar programs with a permanent R & D tax credit should be considered on a program by program basis. From our vantage point within the ATP, it would not be particularly helpful to our company. We spend an average of $1million a month and will incur tens of millions of losses before we turn a profit. In the long-term, such a credit would be helpful, but it would not affect our survival in the early years. The credit is of no value without profits. Such a proposition would be more helpful to the established Fortune 500s. Similarly, long term pre-competitive research will not be the beneficiary of new capital from capital gains tax cuts. Projects like those funded by ATP do not attract even venture capital without the ATP; they are not likely to receive capital as long as they do not yield short term gains.

3. This program hardly qualifies as corporate welfare. The ATP does not award funds to a project that does not hold promise for the future. Nor does the ATP provide unilateral funding. We are required to match, dollar-for-dollar, the federal funds for our program. Fiscal responsibility includes creating an environment where we as a nation invest appropriately in our future. We have a solid history of making these types of investments

years ahead of other countries. This is a program involving cost-sharing and risk-sharing between the private sector and the federal government. About half of the ATP awards go to small companies, a much greater percentage than is typical of other Federal R & D programs.

This program calls for heavy scrutiny in every stage of the project, starting with analysis of initial White Papers proposing areas for competition and investigation, all the way through the actual work on a research project. Each project proposal undergoes extensive scrutiny by a team of experts drawn from the federal government, academia, and the private sector. All projects are selected on the basis of both technical and business merit. Further, once an award is granted, there is strict oversight authority over the grantees to ensure that the required standards are being met and the project well-managed. This is hardly a blind give-away program. Rather, it is one of the most stringent and thorough programs of its kind in either the public sector or the private sector.

4. The ATP grant differs from any other government grant program I am aware of by virtue of the degree of qualified scrutiny given to each proposal. It is my understanding the SBA loans sometimes are used to help launch a small business. The ATP grants do not serve this purpose. These awards go to companies that are already established, to support key research in new technological fields. While SBA loans are frequently viewed as part of a very political system, ATP grants are viewed as their polar opposites. The review process involves experts from the government, academia and the private sector throughout the screening stages. There is no place for politics in this program.

This program fills a unique niche to ensure that pre-competitive, pre-market research is completed. This is an area where the government alone does not conduct such research, but venture capital is rare for such a long investment period. ATP fills this void in two ways. First, its rigorous award process provides an indication to possible investors that the technology has merit. This gives them a sense that their risk has been reduced. Second, the federal funds serve as leverage to reduce the overall private dollar risk. At the same time the requirement for private dollar matching both leverages the federal dollars and protects the federal dollars because they will not be paid unless private money can be attracted to the project. In other words, the ATP projects are too far advanced for full government funding or participation, and commercial exploitation is not far enough along to attract venture capital.

5. I view this not as a case of NIST "taking a chance on a start-up" like mine but, rather, NIST recognizing a high biotechnology field with the potential for future commercial application in several areas. It is not a question of whether this technology will be developed, but more a question of who will develop it, the US or foreign competitors.

The review and selection processes and the experts brought into the process from government, academia and the private sector, provide the specialized knowledge needed to judge which technology fields merit further exploration.

CONGRESSIONAL QUESTIONS AND ANSWERS

From the March 23, 1995 MEP Authorization Hearing

Answers by Lawrence J. Rhoades
President, Extrude Hone Corporation

1. ***Why are small and medium sized manufacturers particularly important to the American economy? What effect has downsizing in the big corporation had on small and medium sized manufacturers?***

Small and medium sized manufacturers employ 12 million people--two-thirds of America's manufacturing workforce providing 57 percent of the national manufacturing payroll. There are 381,000 such organizations in the U.S. By comparison, only 5,000 large manufacturers employ the remaining 6 million manufacturing workers.

To fully understand the importance of small manufacturers to the U.S. economy however, we must first recognize that *manufacturing* is critically important to the nation's economy. It provides 20 percent of the GNP but, more importantly, two-thirds of our export earnings. To appreciate the significance of this, consider the following:

The quality of a haircut in Pittsburgh, Pennsylvania, is about the same as one in Shanghai, China. They each take about 20 minutes of a skilled worker's time using pretty much the same equipment and technology. The U.S. barber, however, can charge about 20 times more than his Chinese counterpart at today's exchange rate because going to Shanghai for a haircut isn't an option. This is not the case with an American manufacturer competing with a Chinese counterpart. Manufactured goods are *transportable* (and storable). You may have noticed American stores and America's homes are filled with foreign manufactured products.

There are dramatic changes occurring in manufacturing today, driven by a dramatic merging of the world's economies. The American manufacturer today must compete with manufacturers from around the world (including China) in a way that service providers like the Pittsburgh barber don't. But, in fact, the barber *is* affected. His earnings (in purchasing power) are defined by the international value of 20 minutes of skilled American manufacturing labor. Manufactured products--not haircuts--are the center of international trade and ultimately determine exchange rates. If the American manufacturing workers' productivity advantages over his Chinese counterpart is no better than the American barber's, there is no basis for a 20 to 1 premium in wages and eventually our exports and foreign exchange rate will reflect this, allowing a U.S. worker, whether they are a barber or a factory worker, to obtain no more value in terms of internationally traded goods for 20 minutes of skilled labor than a Chinese worker earns.

Fortunately, there are quite literally "tools" available to the American manufacturing worker that provide him with a competitive advantage over his Chinese counterpart. Those are the machines, methods and management practices we use in performing our manufacturing operations. Although large U.S. manufacturing organizations have made dramatic changes, they recognized that their size, inertia and bureaucracy (sometimes saddled with intransigent labor union contracts) made their vertically integrated in-house manufacturing units less responsive and more costly than smaller outside suppliers. Consequently, they have downsized dramatically, shedding 25 percent of their workforce--2 million jobs in the past 25 years Small manufacturers added 1.7 jobs during this period--principally as suppliers of manufactured components and subassemblies to the large "downsized" corporations. These small firms are lean and resourceful with an attentive management close to the "shop floor." One disadvantage, however, is the limited availability and relatively high cost of capital to invest in new machinery and methods. Another perhaps more important one is the lack of experience and up-to-date knowledge to determine what investments to make. Yet, the pace of change in manufacturing technology is accelerating. The small U.S. manufacturer's ability to compete--indeed to survive--depends on his ability to get dependable guidance in making these difficult choices quickly.

Although the needs of small manufacturers are common enough to be fulfilled with off-the-shelf (but up-to-date) products and methods, their *implementation* must be *individual*--one firm at a time. This is what MEP centers help do and why they are so urgently needed now.

Big corporation "downsizing" and outsourcing to smaller U.S. suppliers represents a major and dramatic shift in the strategy of the past 25 years from the vertical integration, economies of scale and fear of dependency on outside suppliers that were the foundations of their growth in the first two-thirds of the century. Having taken *this* step, outsourcing to *foreign* suppliers who offer cost advantages over a U.S. supplier is a much smaller step which presents a major challenge to smaller U.S. manufacturers.

The employment in the so-called "industrialized" countries is about 350 million, with an average wage (including fringes) of about $18 per hour. In the past ten years, 1,200 million people with an average wage of under $2 per hour have been added to (or more accurately, have gained access to) the manufacturing sectors of the industrial economies. It is a necessity for big U.S. manufacturers to look seriously at increased outsourcing to foreign suppliers with lower cost labor in order to remain competitive themselves. Only by improving the productivity and responsiveness of U.S. manufacturing (which is increasingly focused in smaller firms) can the loss of manufacturing jobs and the subsequent impact on the rest of the economy be prevented.

2. ***Why is a Manufacturing Extension Partnership necessary? What failure has there been in the market which requires a Federal program like MEP?***

Accessing and gaining the confidence of the diverse (and highly independent) owners and managers of America's small manufacturers is difficult and time consuming. Once a consulting engagement is made, it is likely to be too short to make the effort it took to find it worthwhile for an independent consultant who can look only to his fee for an incentive. If offered a share of the company's increased profits, however, or a share of its growth in payroll, his incentive is enhanced and it becomes a sensible effort for the reward. However, these are precisely the incentives provided to the State and Federal governments whose tax revenues are dependent on the earnings of the company and its workers.

The principle "failure in the market" (if it can be termed one) is that the only organization in a position to have a substantial monetary interest in the collective earnings of the many small manufacturing companies and their 12 million employees is an entity that has not traditionally thought in a market-oriented way--the Federal government.

3. *Who provides services to customer companies? Are these professionals with the appropriate experience?*

The quality of the MEP advisory staff is at the center of its ability to create value, and one of the important reasons for a *national* effort. "Manufacturing extension" is a different task than traditional manufacturing consulting. It requires a combination of engineer, accountant and salesman who is also a good networker and, if possible, a journeyman machinist and a computer whiz. Those who don't fill it bring other equally important experiences and skills, as well as extraordinary energy, patience and discretion. They are also young enough (in attitude at least) to realize that there is enough yet to learn to require listening at least as intently as they advise. They are professionals in a profession that is still being defined. They have hands-on manufacturing experience and include specialists in specific areas critical to modern manufacturing. Many have run small firms and have worked on the factory floor. They are not Federal employees but are employed by non-profit manufacturing extension centers whose boards are typically dominated by people who run successful small manufacturing businesses.

Much of the advice provided by MEP's and taken to heart by their clients comes from peers working in other area businesses that have faced similar problems and implemented various solutions with good (and sometimes not so good) results. Either way, these are lessons learned and the special chance to "envision change" through identifying with a peer's experience. One advantage offered by a national MEP program is a similar chance for MEP's to network and learn from each other. This should extend to developing a "learning track" to more fully define the manufacturing extension profession and to prepare experienced manufacturing people to follow it.

4. *Do the MEP centers compete against private consultants who might do a better job?*

No. In fact, one of the primary reasons that MEP centers exist is to assist small manufacturers overcome the barriers that are keeping them from knowing about and effectively using private and public sector resources. MEP centers complement private consultant services and enhance the small manufacturer market for consultants. MEP centers often retain or encourage companies to retain private sector consultants for specific modernization projects. A recent Dun & Bradstreet Information Services survey confirms that 40 percent of MEP center customers indicated that working with the center made them more likely to use a private consultant.

5. ***Are changes in Federal tax policy an alternative to the MEP program? Wouldn't reducing deficit spending by cutting the ATP program provide more benefits to small and medium sized businesses?***

It is appropriate--in fact, necessary--if we are to remain internationally competitive as a nation, for our federal government to acknowledge and step up to its role as a partner in America's small manufacturing enterprises--sharing their challenges as well as the profits and wages they generate. MEP and ATP are complementary programs that do just that.

MEP assures that America's smaller manufacturers are using up-to-date manufacturing technology, and ATP brings new technologies to the national manufacturing arsenal to maintain our productivity advantage while our global competitors adopt our current methods. Without the collective national investment in both areas, the current productivity advantages of American manufacturers over their international competitors with lower wage rates will fade. The profits, wages and export earnings of this large and central element of the nation's economy will fade as well, generating a loss of tax revenue that could make the budget deficit widen dramatically, regardless of the tax *rate*. Curtailing investments in MEP (or ATP) is like "saving" money by refusing to fix the roof--the problem just gets worse.

A Federal tax policy that genuinely encourages investment in technology that enhances the productivity of small U.S. manufacturers would indeed be welcome and helpful. The guidance provided by MEP centers in assuring that those investment decisions are well informed and fully implemented would be a valuable as the tax incentives itself.

6. ***How long should Federal funds support individual MEP centers? Do you believe that a center should re-compete for funds after a certain time period?***

Because of the importance of small manufacturers and the value centers deliver to U.S. taxpayers, Federal funds should be a component of the support that individual MEP centers receive for as long as a center:

- is making a difference with small manufacturers;
- has strong support from the marketplace;
- has strong financial support beyond the Federal investment;
- passes aggressive third-party performance reviews with distinction; and
- continues to provide a high return on the Federal investment in the form of tax revenue base, jobs, export dollars and other returns contributed by healthier, more competitive, small manufacturing customers.

While we do not believe that re-competing for funds through a formal solicitation process would be cost effective, each center should (and does) receive continued funding solely based on performance. Each center is reviewed annually, with more extensive reviews conducted during the center's third and sixth years of operation. Centers that do not perform satisfactorily have an opportunity to correct their performance. If they don't, Federal funding is withdrawn.

In any event, it is critically important to continue to support the early MEP centers for the next several years at least because they are the "models" and the training centers for the newer centers that are now getting started. It would indeed be unwise to lose those lessons learned and recover the ground they pioneered.

7. ***Could the MEP centers become self-sufficient by charging for their services? What would be the consequence of requiring MEP centers to become self-sufficient?***

For an enterprise to become profitable (or even self-sufficient), it must first create economic value for those it serves and, second, find a mechanism to capture a portion of that value for itself. MEP centers engage in a variety of activities to benefit small manufacturers. Many of those that create the most value are difficult to commercialize. One example of this is "networking"--introducing and facilitating discussions and experience sharing among complementary companies. They can become advisors to each other and can be an extremely effective catalyst in accelerating a small manufacturer's sometimes frightening commitment to making the positive changes needed to modernize and become competitive. Often needed manufacturing equipment can represent a substantial percentage of a firm's net worth. Networking, facilitated by the MEP center, can enable companies contemplating such investments to "envision" the change by arranging for teams of those directly affected by the change to visit companies that have already implemented such changes in various ways. Such activities would likely be curtailed or eliminated if MEP centers were required to be self-sufficient since, in spite of the tremendous value, such "network" sharing would be very difficult to solicit if it were felt to be "commercial."

8. ***In a number of instances, states have supported manufacturing extension programs. Since that is the case, why are Federal funds necessary?***

Some states *have* taken the initiative to establish manufacturing extension programs. Typically, these programs were established in states and in specific areas that had already suffered great financial and economic hardships because of the loss of manufacturing jobs--such as in Cleveland and in Pennsylvania. In other states, however, Federal funding through NIST MEP and through the Technology Reinvestment Project and Federal commitment to the importance of manufacturing for a healthy economy served as the catalyst for establishing manufacturing extension programs. This Federal initiative has enabled some states to improve their manufacturing base *before* facing similar economic crises.

In either case, the Federal role is two-fold: (1) providing funds to establish or enhance states' manufacturing extension efforts; and (2) providing national resources and national leadership needed for this national priority. Specifically, Federal involvement through NIST MEP:

* provides a focus on the *nation's* manufacturing competitiveness--not just a *single state's* competitiveness;

* is needed to address the fact that the productivity of small manufacturers lags that of larger firms;

* is needed because industry issues and challenges don't stop at a state's border, but often require a regional or national approach;

* provides for better use of public funds by developing common tools, resources, and information needed to support multiple states' efforts;

* provides common performance criteria--and conducts third-party performance reviews--ensuring accountability and best return on investment;

* creates partnerships to benefit small manufacturers that otherwise would not occur (EPA, Department of labor, etc.);

* stimulates innovation by centers that benefits small firms and the economy, such as encouraging centers to integrate environmental perspective, sharing best practices, requiring continuous improvement.

9. ***In your opinion, what would be the consequences of stopping all Federal funding for the MEP centers within the next two years?***

Stopping federal funding for the MEP centers would throw the nation's severely challenged manufacturing economy further back in the race to compete globally. Continuing trade deficits and falling dollar exchange rates emphasize that we are not winning this race. Profits, wages and exports would fall, and our trade and budget deficits would widen further. If we cannot accelerate the implementation of advanced (or at least up-to-date) manufacturing technologies into our manufacturing factory floors, our national standard of living will steadily decline. The MEP centers are the country's most focused effort to assist in this implementation.

10. ***How has the MEP program changed since its beginning? What were the reasons for these changes?***

When MEP was established in 1988, the primary objective of the program was to transfer new technologies from Federal labs (especially NIST labs) to small manufacturers, with manufacturing extension centers generating revenue through licensing of those technologies. The experience gained in the early MEP efforts taught many lessons, and methods to more effectively provide manufacturing extension support were developed. These methods continue to be refined and manufacturing extension methodology is maturing.

That objective changed when centers discovered that most small manufacturers are not yet using *current* off-the-shelf technologies. These companies need assistance moving from using twenty year old technology to using *current* manufacturing technologies and techniques. They are *not* ready to consider integrating or applying unproven *new* technologies.

This discovery changed both the focus of MEP centers' work and the basis for MEP centers to become self-sufficient.

11. We hear a lot of talk about the global marketplace. Do small and medium sized manufacturers face competition from foreign companies in markets here in the United States? How does the MEP program help them meet the challenges of foreign competition?

I believe this is covered in my response to Question #1.

CONGRESSIONAL QUESTIONS AND ANSWERS

Jan Pounds, Director
Massachusetts Manufacturing Partnership
Bay State Skills Corporation

Questions & Answers

1. *Why are small- and medium-sized manufacturers particularly important to the American economy? What effect has down-sizing in the big corporation had on small- and medium-sized manufacturers?*

The 381,000 small- and medium-sized U.S. manufacturing establishments nationwide (98.7 percent of the total manufacturing establishments) are important to the American economy because:

a. they employ almost 12 million people (65 percent of the manufacturing work force);
b. they account for a combined annual payroll of more than $322 billion (just over 57 percent of the manufacturing payroll);
c. they have been responsible for the manufacturing sector's only job growth in recent decades;
d. each manufacturing job typically requires service-related jobs needed to support manufacturing (accounting, marketing, transportation industry, etc.)

Down-sizing by large corporations has increased the importance of these small manufacturing firms as a critical supplier base for producing parts, components and tooling for the larger companies -- and as a source of job growth for the nation. While manufacturing employment in large firms declined by 2 million between 1967 and 1992, employment at small firms grew by 1.7 million.

2. *Why is a Manufacturing Extension Partnership necessary? What failure has there been in the market which requires a Federal program like MEP?*

Census Bureau data and other studies indicate that smaller manufacturers generally use fewer technologies and are less productive than larger firms. There are a number of reasons for this. According to the National Research Council, smaller firms lack the in-house expertise, time, technical information and funds required to improve their operations. They also are unaware of advancements that could benefit them or of where to find practical, unbiased assistance.

While these needs exist, there are few resources in the marketplace working on addressing them. Because of the high cost of selling and marketing to smaller manufacturers, most consultants and consulting firms choose to work with larger firms. Consultants that do choose to work with small firms often face difficulties identifying and selling to them because small firms typically have little or no experience in working with outside consultants.

MEP centers fill this gap in the marketplace by making small firms aware of the technologies, techniques and resources that can assist them in becoming more competitive, and by serving as an unbiased advocate to stimulate the company's modernization efforts. Many countries, including our strongest trade competitors, have been undertaking similar strategies to bolster the competitiveness of their small manufacturers for decades.

3. *Who provides services to customer companies -- are these professionals with the appropriate experience?*

MEP centers are staffed by professionals who have hands-on manufacturing experience. While some of these staff specialize in certain technologies or modern manufacturing techniques, the majority have broad manufacturing experience gained on the shop floor, from running a small firm, or from other manufacturing industry positions. Staff are employed by the non-profit manufacturing extension centers, and are not federal government employees.

Through MEP center staff, small manufacturers also gain new access to and assistance in connecting with public and private sector consultants, technology vendors, state and federal resources, assessment tools, databases, electronic networks, and new sources of information, technologies and manufacturing techniques.

4. *Do the MEP centers compete against private consultants who might do a better job?*

No, in fact, one of the primary reasons that MEP centers exist is to assist small manufacturers overcome the barriers that are keeping them from knowing about and effectively using private and public sector resources. MEP centers complement private consultant services and enhance the small manufacturer market for consultants. MEP centers often retain or encourage companies to retain private sector consultants for specific modernization projects. A recent Dun & Bradstreet Information Services survey confirms that 40 percent of MEP center customers indicated that working with the center made them more likely to use a private consultant.

5. *Are changes in Federal tax policy an alternative to the MEP program? Wouldn't reducing deficit spending by cutting the ATP program provide more benefits to small- and medium-size businesses?*

Changes in the tax code that create incentives for small- and medium-sized manufacturers to invest in new technologies would be a complement to, not a substitute for the work of MEP. That's because tax changes do not succeed in helping small manufacturers become aware of, and use technologies, manufacturing practices and public and private resources needed for them to be competitive in the future. MEP helps companies understand and make CHANGES that help them improve.

6. *How long should federal funds support individual MEP centers? Do you believe that a center should re-compete for funds after a certain time period?*

Because of the importance of small manufacturers and the value centers deliver to U.S. taxpayers, Federal funds should be a component of the support that individual MEP centers receive for as long as a center:

- is making a difference with small manufacturers;
- has strong support from the marketplace;
- has strong financial support beyond the federal investment;
- passes aggressive third-party performance reviews with distinction; and,
- continues to provide a high return on the federal investment in the form of tax revenue base, jobs, export dollars and other returns contributed by healthier, more competitive, small manufacturing customers.

While we do not believe that re-competing for funds through a formal solicitation process would be cost-effective, each center should -- and does -- receive continued funding solely based on performance. Each center is reviewed annually, with more extensive reviews conducted during the center's third and sixth years of operation. Centers that do not perform satisfactorily have an opportunity to correct their performance. If they don't, federal funding is withdrawn.

7. *Could the MEP centers become self-sufficient by charging for their services? What would be the consequence of requiring MEP centers to become self-sufficient?*

MEP centers could become self-sufficient IF THEY STOP FOCUSING ON THE NEEDS OF SMALL MANUFACTURERS. If it was profitable to service the needs of small manufacturers, the marketplace would already be doing it -- and MEP centers would not be needed to begin with. The fact of the matter is, the high cost of marketing to and servicing the needs of small manufacturers, for the most part, makes it prohibitive to be self-sufficient.

The consequence of requiring MEP centers to become self-sufficient would likely be centers evolving into private for-profit consulting firms competing for the business of larger manufacturers -- an end far different than the modernization of America's small and medium-sized manufacturers.

8. *In a number of instances, states have supported manufacturing extension programs. Since that is the case, why are Federal funds necessary?*

Some states have taken the initiative to establish manufacturing extension programs. Typically, these programs were established in states and in specific areas that had already suffered great financial and economic hardships because of the loss of manufacturing jobs -- such as in Cleveland and in Pennsylvania. In other states, however, federal funding through NIST MEP and through the Technology Reinvestment Project and federal commitment to the importance of manufacturing for a healthy economy served as the catalyst for establishing manufacturing extension programs. This federal initiative has enabled some states to improve their manufacturing base BEFORE facing similar economic crises.

In either case, the federal role is two-fold: 1) providing funds to establish or enhance state's manufacturing extension efforts, and 2) providing national resources, and national leadership needed for this national priority. Specifically, federal involvement through NIST MEP: provides a focus on the NATION'S manufacturing competitiveness, not just a SINGLE STATE'S competitiveness; is needed to address the fact that the productivity of small manufacturers lags that of larger firms; is needed because industry issues and challenges don't stop at a state's border, but often require a regional or national approach; provides for better use of public funds by developing common tools, resources, and information needed to support multiple states' efforts; provides common performance criteria -- and conducts third-party performance reviews --ensuring accountability, and best return on investment; creates PARTNERSHIPS to benefit small manufacturers that otherwise would not occur (EPA, Dept. of Labor, etc.); stimulates innovation by centers that benefits small firms and the economy -- such as encouraging centers to integrate environmental perspective, sharing best practices, requiring continuous improvement; provides U.S. small manufacturers with the same resources that manufacturers in other countries have -- supporting small firms has been part of other national governments' strategic plans for years.

9 *In your opinion, what would be the consequences of stopping all Federal funding for the MEP centers within the next two years?*

If federal funding for the MEP centers was eliminated within the next two years, some states that have established a manufacturing extension program -- either on their own initiative or as a result of NIST MEP -- would continue their efforts for at least a year or two. However, it is unlikely that those states would be able to make up the lost funding; therefore, these centers would likely work with fewer small manufacturers, lessening the overall economic impact and outreach.

Many other states have just started their manufacturing extension efforts and have not yet had the opportunity to realize benefits from the program. Without federal funding, these states may lose their incentive -- as well as their ability -- to invest in their manufacturers.

Without federal funds, state efforts are likely to remain focused on individual state "protectionism" related to attracting firms across state lines, rather than focusing on the nation's overall manufacturing competitiveness and strategies that encourage regional or industry approaches and cooperation.

Lastly, without a federal role, it will be difficult for states to leverage national resources, form national partnerships and address broader national issues related to small firm competitiveness.

10. *How has the MEP program changed since its beginning? What were the reasons for these changes?*

The MEP program has changed in one major way: when MEP was established in 1988, the primary objective of the program was to transfer new technologies from federal labs -- especially NIST labs -- to small manufacturers, with manufacturing extension centers generating revenue through fees, royalties and licensing of those technologies.

That objective changed when centers discovered that most small manufacturers are not yet using existing off-the-shelf technologies. These companies need assistance moving from using 1930s and 40s technology to using current manufacturing technologies and techniques. They are NOT ready to consider integrating or applying NEW technologies.

This discovery changed both the focus of MEP centers' work and the basis for MEP centers to become self-sufficient.

11. *We hear a lot of talk about the global marketplace. Do small- and medium-sized manufacturers face competition from foreign companies in markets here in the United States? How does the MEP program help them meet the challenges of foreign competition?*

As information technologies bring continents, customers, and suppliers closer together, smaller firms -- whether they be in Storrs, Connecticut; Elbow Lake, Minnesota; or Silver City, New Mexico -- are competing with firms around the world. Armed with those information technologies, large firms are outsourcing to smaller firms that are cost-effective, on time, and can meet their quality specifications and needs -- regardless of wether that firm is in the U.S. or across the globe. Large firms must follow this strategy if they are to remain competitively viable themselves. In addition, large and small firms alike face ongoing competitive pressure from the global marketplace to continue to improve their performance, no matter what level of performance they have achieved today.

The Manufacturing Extension Partnership helps small manufacturers meet the challenges of global competition by making them aware of appropriate technologies, modern manufacturing processes, and current business practices that can enable them to lower costs, improve productivity, enhance quality, and increase market share. MEP also helps connect small manufacturers with outside private and public sector resources that can help them apply those technologies. And, perhaps most importantly, MEP serves as a catalyst for firms to establish a culture of continuous improvement and a realization that "lifelong learning" must be practiced throughout the company if they are to survive.

CONGRESSIONAL QUESTIONS AND ANSWERS

Arthur J. Caisse
President and CEO
Cubicon Inc.

Cubicon Inc.

5 May, 1995

Dear Sirs,

The following is my response to your questionnaire:

1. How would the following scenario affect entrepreneurship:

a) Provide capital gains tax cuts and ease regulations to stimulate industrial research and development:

Any actions or incentives that would direct more funds into research and development will benefit entrepreneurship. However, to get the most leverage out of such redirected funds, the dynamics of any such incentive plan should be such that research and development that pays off in commercial ventures that benefit the economy is what is rewarded.

b) Concentrate Federal dollars on basic research?

Again, while basic research is better than no research at all, research that does not lead to commercialization should be distinguished from that which by design produces identifiable benefits to the economy. Putting Federal dollars into research endeavors should be thought of more as venture captialist investors do. The fact is that the Government is the venture capitalist for the taxpayer, it invests the tax payers dollars in America's future; and as such it should always look for the financial return in doing so.

c) Get the government out of development of commercial technologies by abolishing the ATP, TRP, Sematech, and other similar applied research programs?

Definitely not; at least not the ATP. The Goal of the ATP funding is:

"... high-risk research and development projects leading to practical technology that will ...stimulate *economic growth* and *job creation* through the development of *new industries.*"

Corporations certainly create new products and technologies in order to grow revenues and of course this creates jobs as well. And they fund research to do this. However, their priority is next year's bottom line. When profits are threatened, research funding suffers. Matching ATP funds can and do encourage corporate investment in high-risk, high-potential research during 'tight' times . This leverages corporate assets in America's interests.

However, at least established corporations have the option and resources with which to pursue breakthrough research if they choose. This is not true for the start-up.

Startups can be characterized as a small group of technological talent combined with real-world experience, credibility and a vision of a technological breakthrough that meets a specific market need. And NO MONEY.

In order to obtain funding from the venture capitalist community they must meet two other very specific criteria. They must produce a product in 18 to 24 months, and provide a return on investment to the venture capitalist of about five times in five to seven years. And of course the VCs opt for those opportunities with minimal risk. Therefore, these start-ups typically only push the envelope of the existing technical paradigm. They deal in 'incremental' progress. It's safer.

This 'filter' means that opportunities that are apt to produce breakthroughs or paradigm shifts, the kind that might create totally new industries, are passed over. The ones that could produce paradigm shifts, achieve technological breakthroughs and create new businesses. The very kind that the ATP program aspires to promote because it will grow the GNP.

And so that leaves the far-reaching entrepreneur with few places to go for funding; adding to his already formidable task. There has been almost no source of funding that these pioneers could obtain; until the ATP came along.

Without the ATP America misses an opportunity to leverage one of its most valuable resources, the highly motivated pioneering spirit of the entrepreneur.

d) Streamline procurement policies to ensure that the latest technologies are rapidly incorporated into weapons, space vehicles, and the like?

The same decision process described above should be applied to these type of investments as well. That is, there must be some economic potential to justify the investment. Certainly the safeguarding of America is an economic consideration. However, hopefully the world will eventually evolve into a safer place. It follows than that those investments that can also demonstrate the potential for non military returns should be given preference.

2. Would replacing the ATP program, SEMATECH, and all similar programs with a permanent R&D tax credit and reduction in capital gain rates be more helpful to entrepreneurs like you or to Fortune 500 companies?

Replacing the ATP would harm the Fortune 500 company, but would eliminate America's most important startups: the high risk, high return ones. The ones that can make a positive difference in the GNP. There is a huge difference between a large corporation and a startup. For the Fortune 500, or any existing company with resources, it is a corporate decision as to whether to do research or not. For high risk startups , the research aspect of the venture represents such a high risk factor, that venture capitalists won't fund it. Without the ATP, it would have no resources.

The venture capitalist's charter is to minimize risk to increase the probability of profits. Their backers demand it. It's too risky to tackle long-range technological breakthroughs; even though the returns could be huge. VCs can please their investors with more moderate returns; and the odds are better. Hence they insist on ventures that produce product in 18-24 months and return 5 times their investment in 5 years.

The goal of the ATP has been made very clear It only funds:'... high-risk research and development projects leading to practical technology that will ...stimulate economic growth and job creation through the development of new industries." ATP targets high risk projects for only one reason: they're the ones that have the potential to produce the returns needed to create significant growth in the economy.

It requires a cognitive leap; the paradigm shift to make that kind of a difference. It's not 'incremental' research that extends todays products year by year. It's not 'business as usual'.

The startup is the Fortune 500 company of the future. Without the ATP it wouldn't exist. Eliminating the ATP will abort these new important ventures before they are born.

3. How do you respond to criticisms that the ATP program is unjustifiable corporate welfare?

The ATP is not committing corporate welfare in the case of the high-risk startup; nor is it picking winners and losers, as is also sometimes alleged.. .I can't speak for the Fortune 500 company. They at least have the luxury of deciding what to fund. But for the startup, the situation is very different.

By funding these start-ups that wouldn't otherwise be in the game, ATP isn't choosing among existing contestants, they are creating new players; on America's team. And ATP doesn't just offer them a 'dole'. Far from it, ATP requires each bidder to demonstrate how they will become self-sufficient. It requires them to show that the return is significant enough to warrant the risk.

And the resulting wins ripple through the economy and convert the welfare ranks to taxpayers.. They create more jobs and wealth for America; they buy school lunches with wages; not taxes. By design, the ATP is not recurrent welfare. It's a pro-active strategy that will create jobs; and in a large way. Rather then create corporate welfare, the ATP helps eliminate personal welfare.

4. What are the unique characteristics of an ATP grant? Is there any unique niche it fills vis a vis other government programs or venture capital assistance?

The ATP fills a very specific and important gap in America's investment strategy. It funds those ventures that can positively affect the GNP but are so high risk that they can't get funding elsewhere in the USA.

Venture capitalists don't invest in 'high-risk' ventures. Their charter is to minimize risk to increase the probability of profits. Corporations are not in the business of the venture capitalists, nor do they share the goals of the ATP. Corporate directors are bound by their fiduciary mandates to promote their company's prime interests and strategies always leading to shareholder profit. The non-profit research centers don't have the charter or infrastructure to carry on past the research phase to commercialization .

So where does the high-risk, high-potential start-up go for funds? Ironically, the very entities that set goals so high they could benefit the whole economy, are left to their personal funds, or those of friends and family; to work out of their kitchens and garages. Until the ATP. ATP targets just these ventures. In fact, by design, if a start-up did qualify for classical venture funding, the ATP funds would not be made available; on that basis alone.

Take away the ATP and the only other options for the high risk startup are outside of the USA. The question isn't whether or not tomorrow's solutions will be found; it's who will do it?. If we don't, other countries will. We've seen the effects of believing America couldn't be surpassed in industry. Other counties like Japan support their own industries through programs like MITI. They also pursue America's talent when our classical funding abandons them. From my own experience I have seen that non-U.S funds are often easier to come by.

Cubicon Inc.

The ATP is the alternative for the high-risk/high potential innovators. America's option is "use them or lose them".

America needs to invest in world market preeminence if that is what it wants. The current paradigm for commercial investment in America is not charted to pursue the larger goals of the ATP. It deals mainly in incremental extensions of technology.

It is the far-reaching start-ups, targeting difficult but substantial results, populated by highly motivated entrepreneurs, that by definition produce new industries, markets and jobs. These high risk start-ups, the ones that because of the magnitude of their goal, can't get conventional venture funding, are the very ones likely to produce whole new industries or revolutionalize existing ones.

We want them to overcome the technological challenges required for a breakthrough advance. We want them to take on the global market competitors to an extent that they affect the balance of trade. But without the ATP, there is no support system. They are left to pull off this amazing feat, this breakthrough in both business and technology, on their own. We demand they start from scratch. Until the ATP.

Question for Arthur Caisse:

1. You are one of several companies which have been given grants to develop a new class of computer software. Do you consider it a problem that NIST is funding multiple paths to the same solution?

Absolutely not! The issue is that America come up with the commercially viable answers. More players increase those odds. And competition fuels each participant. It is the dynamic that has kept America at the forefront of technological breakthroughs and world market dominance.

Whether ATP funds should be given to foreign researchers is another question. My answer is a qualified yes. By that I mean that funds should only be provided foreign participants carefully. I don't have the answer, nor is there enough room or time here to explore it.

But multiple paths to the same solution? Yes; and we welcome the competition.

APPENDIX II

Statement of Dr. Robert W. Lucky
Chairman, Visiting Committee on Advanced Technology
of the National Institute of Standards and Technology
before the
Subcommittee on Technology
Committee on Science
U.S. House of Representatives

March 23, 1995

Mr. Chairman and Members of the Committee:

I am pleased to appear before you today as the Chairman of the Visiting Committee on Advanced Technology, an independent, private sector advisory body to the National Institute of Standards and Technology. I will summarize our committee's findings and recommendations regarding NIST and its programs, and discuss several budget issues.

Our committee in 1994 included eight other members with diverse backgrounds. Dr. Robert Hermann, who was recently elected by the committee to replace me as Chairman, and who is Senior Vice President, Science and Technology, United Technologies Corporation; Dr. Edward Chait, Vice President of Business Development, Intergen Company; Fred Kittler, Vice President, J.P. Morgan Investment Management Inc.; Robert Saldich, President and CEO, Raychem Corporation; Dr. Maxine Savitz, General Manager of Ceramics Components, AlliedSignal; Dr. G. King Walters, Professor of Physics, Rice University; Dr. Albert Westwood, Vice President, Research & Exploratory Technology, Sandia National Laboratories; and Dr. George Whitesides, Mallinckrodt Professor of Chemistry, Chemistry Department, Harvard University.

With this statement, I conclude a term on the NIST Visiting Committee that began in 1992. During my term, NIST has evolved faster and further than in any other comparable period in its history. With the Omnibus Trade and Competitiveness Act of 1988, Congress changed the agency's name to symbolize a broader mission, gave it powerful new programs for working with industry, and called upon it to step up its efforts to spur the American economy by supporting the development of commercial technology.

NIST has responded to this challenge in impressive fashion. With the persistence and foresight of this committee and others in the federal government who believe in technology as a driver of economic competitiveness, NIST's budget has grown significantly. NIST has capitalized on this budget growth to increase the impact of its forward-looking programs. The President's 1996 budget, now before the Congress, includes a solid commitment to NIST's civilian technology programs.

We are well aware, however, that money is tight and that there are many competing demands for it. In a budget climate where many cuts and outright elimination of some programs are being proposed, NIST is slated for a substantial increase. In these circumstances, I want to make two main points today:

- First, NIST's programs are, in our opinion, among the federal government's best, most cost-effective ways to support the American economy.

- Second, NIST is prepared with solid, carefully thought-out plans in all of its program areas to use the proposed budget increase productively.

NIST's impressive performance in recent years inspires confidence that the increased funding proposed will be used to good advantage in support of American industry and competitiveness. I will illustrate this with a brief discussion of each of NIST's four major program areas. Many of my comments are expanded in our 1994 annual report, which I submit as an attachment to my statement.

The Advanced Technology Program (ATP)

The Advanced Technology Program (ATP) was created in 1988 to invest directly in U.S. industry to develop high-risk, enabling technologies that can lead to advanced products, manufacturing processes, and services with potentially large economic benefits to the nation. It directly addresses concerns about intensified foreign competition in a global market at a time when there is reduced long-term R&D investment by industry and greatly reduced defense investment in industry. The ATP addresses these concerns by fostering the development of enabling technologies that would not be pursued, or would not be pursued in a timely manner, by private funds alone. U.S. industry must lead the preparation of technology development proposals to the ATP, must cost share, and must demonstrate a commitment to downstream commercialization. However, the ATP does not fund product development, although a number of "spin-off" products have already resulted from ATP-funded projects. Our October 1993 report on the ATP gave some examples. A number of other examples are given in "NIST Industrial Impacts, A Sampling of Successful Partnerships" (1994). The ATP is regarded enthusiastically by U.S. business, is supporting the development of many exciting technologies, and shows promising short-term indicators of success.

Companies funded by the ATP assert that they have been helped to accelerate technology development and commercialization by funding high-risk research and development that would not have been done otherwise or would have been done too late to capture the appropriate market. The ATP has also clearly catalyzed the formation of consortia among companies, and also among universities, and government laboratories which were unlikely to have occurred without the ATP. From our contacts it is clear that present competitive markets pressure companies toward taking a short-term view. However, the ATP encourages companies to take a longer-term outlook. It also stimulates them to form alliances with other companies which might not otherwise occur. ATP is open to companies of all sizes – from startups to major corporations. About half of the awards to date have been made to small businesses, reflecting the entrepreneurial strength in these firms. Even in the case of large companies, the ATP process stimulates entrepreneurial efforts within these companies.

In its first four years, the ATP held four general competitions open to all areas of technology. Proposals from industry are not evaluated on the basis of the specific technology proposed but rather on the quality of the proposal and on the potential economic impact. The criteria used for evaluations are:

☐ scientific and technical merit;

☐ the potential for broad-based economic benefits;

☐ plans for eventual commercialization of the research;

☐ the experience and qualifications of the proposer; and

☐ evidence of the proposer's level of commitment to the project, and clarity and appropriateness of the proposer's management plan.

We have advocated strategic management of the ATP, that is, careful study and consultation with industry to invest funds where they can really make a difference. As a result, we fully support NIST's development of focused programs, that is, coordinated, multi-venture programs in strategically important technologies. I am speaking of support for technologies that command large, and more importantly, growing markets. These technologies will drive the economy of the twenty-first century. Our global competitors intend to win in these technologies; therefore this is a race in which we must compete.

The approach used by the ATP for selecting focused programs is the same as that used in project selection for the general competitions – let the ideas come from industry and select on the basis of clear evaluation criteria. The criteria used for selecting focused programs are:

☐ potential for U.S. economic benefit;

☐ strength of the technical ideas;

☐ evidence of strong industry commitment; and

☐ the opportunity for ATP funds to make a significant difference.

ATP competitions within the focused programs will fund specific projects, using the same procedures and selection criteria used for general competitions. In developing focused programs, the ATP has actively solicited industry involvement through requests for "white paper" proposals, sponsorship of numerous workshops, and many individual contacts. We strongly support this strategy of selecting focused programs on the basis of ideas from industry, rather than on the basis of personal judgments.

In April 1994, the ATP announced five focused programs. In December 1994 it announced six additional focused programs. The ATP has done an outstanding job over the past year in developing and running one general competition and five focused competitions and announcing awards for all of these competitions.

The Manufacturing Extension Partnership (MEP)

The Manufacturing Extension Partnership is now building rapidly on its solid success with seven extension centers in Fiscal Year 1993 increasing to 35 extension centers in Fiscal Year 1994 and to 80 extension centers in the current fiscal year. Of these 80 centers, 37 are planned to be funded by the Technology Reinvestment Program and managed by the MEP. We conclude that the MEP is an outstanding example of what the federal government can do to help small and mid-sized American manufacturers stay competitive. For example, the centers estimated that between 1989 and 1993 the client companies realized $7 in economic benefits from formal technical assistance for every Federal dollar spent.

Each manufacturing extension center is proposed locally and tailored to the needs of the local business base by people who know and understand it. The center employees are all local employees, not Federal employees. The centers are so well integrated into the local industrial fabric that many of its beneficiaries think of it as a local resource rather than a Federal one.

The changes necessary for the MEP to integrate its manufacturing extension centers, state technology extension programs, and other activities into a comprehensive, national manufacturing support network are well underway. Legislation is in place which allows the MEP to fund up to one-third of the operating costs of the three oldest manufacturing centers for a seventh year, contingent on continued satisfactory performance. MEP's experience indicates that revenue generated by the centers will not be sufficient to cover the costs of providing services to the smaller manufacturers. To enable continued focus on meeting the needs of small manufacturers, we recommend Federal support for the centers beyond the sixth year of operation.

Science and Engineering Research

The NIST laboratories continue to excel in working with companies and consortia. We have heard praise from their corporate customers for their industry-oriented culture, technical strength, and commitment to collaboration at all levels. There are hundreds of these collaborations at any given time and they take many forms, from Cooperative Research and Development Agreements, in which NIST is a leader, to technical support of companies that are funded by the Advanced Technology Program.

NIST's laboratories do world-class research, but their strong ties to industrial technology assure that they will apply their strengths to real-world problems. They provide the kind of infrastructural technology that America's companies need to develop, evaluate, and certify the performance of new, high technology products. They have an enormous job to do, and industry is constantly calling on them to do more.

The NIST Director, Dr. Arati Prabhakar, is a strong supporter of the laboratories and their standards and measurement mission. She knows, as do we, that the laboratories are playing catch-up after years of inadequate budgets for both research programs and for facilities. The technical initiatives of the laboratories are timely and address key national technology needs. The restoration of NIST's research facilities to world-class condition is long overdue. We give these items a very high budget priority for Fiscal Years 1995 and 1996 and we urge you to do the same.

We support the NIST strategy of using its increased laboratory funding to emphasize quality and mission focus rather than staff growth. Replacement of present contract research will allow NIST to take greater control over its research agenda and sharpen its focus on support to industry.

NIST has announced plans to form a new Information Technology Laboratory. We believe that this can strengthen NIST's ability to support interoperability and standards in an area vital to the United States.

It is important to note that the laboratories created and propagated the technical culture and commitment to excellence that drive all of NIST's programs. They are the reason that the Advanced Technology Program, the Manufacturing Extension Partnership, and the Malcolm Baldrige National Quality Program were put at NIST in the first place. I cannot say this too strongly: the laboratories are the core of NIST, and their vitality is essential to its success.

The Malcolm Baldrige National Quality Award Program

In a short time, the Baldrige National Quality Program has become the leading symbol of America's renewed commitment to quality. The program has strong support among leading American companies, and it has increased enormously the understanding and application of quality principles in this country. The Baldrige Award is the program's most visible activity, but its real contribution is the underlying work of quality outreach to companies at all stages of development of quality programs. Since 1988, over one million copies of the award criteria have been distributed. An annual conference at which award winners present details of their quality improvement strategies and results has been established. Award winners have shared information with hundreds of thousands of companies, educational institutions, government agencies, health care agencies, and others. The award has thus had an impact which reaches far beyond the award winners.

The Baldrige program has now geared up to address new challenges. Criteria for quality performance have been developed and published for the education and health care industries. Efforts are well underway to run pilot programs for both education and health care. However, this much-needed application of quality principles to education and health care would be derailed by the House-proposed rescission for the Baldrige program. We urge you to reconsider this action.

The Future

In summary, NIST's programs are carrying out important work, have been well-managed, and have performed superbly. NIST has demonstrated that it can scale up its programs quickly, while maintaining their quality and effectiveness. This has been particularly noteworthy in the Advanced Technology Program, which has gone from one general competition per year to one general competition plus ten focused program competitions in FY 1995; and in the Manufacturing Extension Partnership, which has gone from seven manufacturing extension centers in 1993 to 44 centers early in Fiscal Year 1995.

The scale-up of the ATP, MEP, and Baldrige programs has been carried out with very modest staff increases. In order to take control of its own agenda, the NIST strategy, which we believe is the correct one, calls for the use of increased funding to reduce the rate of support of laboratory programs by other agencies to about 20% by Fiscal Year 1997, with no increase of laboratory staff. The Fiscal Year 1995 budget, without rescissions, will enable a reduction to about 25% in the rate of support by other agencies. This will be accomplished by replacing contract research that is not strongly tied to NIST's industrial support mission with more industry-focused base-funded research. This would address a concern which we have had for several years. Across the NIST laboratories in Fiscal Year 1990, other agency funding averaged about 33% and in some divisions the figure was substantially higher. We fully support NIST's strategy, and urge that you support it.

Much of NIST's strategic effort this year has concerned the setting of priorities and the measurement and assessment of effectiveness in each of the four major program areas, that is, the impact on customers in industry and elsewhere. A report was issued by NIST in January 1994, "Setting Priorities and Measuring Results at the National Institute of Standards and Technology," which discusses how NIST is addressing these issues. Also issued during 1994 was a report, "NIST Industrial Impacts – A Sampling of Successful Partnerships." The operational aim is to focus and leverage Federal expenditures so that relatively small investments yield meaningful economic benefits for the nation. We believe that this is a sound and essential approach during a time of constrained Federal budgets and growing economic competition.

Measuring the impact of results is not easy. The impacts of NIST's programs are at times quite direct and readily measurable. Often, however, the impacts are diffuse, and the beneficiaries may not even appreciate, let alone be able to evaluate, the extent of NIST's contribution. We believe that NIST should be commended for addressing these very difficult questions. Our 1994 report describes some of the very encouraging results.

In conclusion, we are confident that NIST is ready to use the 1995 and 1996 budget increases effectively. The laboratories are ready with technical initiatives that address key national needs. The ATP has demonstrated its ability to plan and execute focused programs that will accelerate progress in key technologies. The MEP is well along in building a comprehensive, national manufacturing support network that we believe will be a major national asset. The Baldrige program will continue its work with industry while taking the quality message to the education and health care communities. Across the board, NIST has demonstrated that it can deliver.

Furthermore, NIST has the full backing of the Department of Commerce. The Department has worked very hard to provide NIST with the resources it needs, and deserves the thanks of those in the industrial and technical communities who view the President's 1995 and 1996 budgets for NIST as very good signs. Secretary Brown made his commitment very clear when I met with him earlier this month to present the Visiting Committee's annual report.

The budget before you will accelerate programs with proven effectiveness – programs that owe a great deal to your committee, and that, we believe, merit your support.

That concludes my statement. Thank you for the opportunity to present the Visiting Committee's views. I will be happy to answer any questions that you may have.

Robert W. Lucky
Chairman
Visiting Committee on Advanced Technology
National Institute of Standards and Technology
1994

Robert W. Lucky is Vice President of Applied Research, Bellcore.

Until September of 1992 Dr. Lucky served as Executive Director of the Communications Sciences Research Division of AT&T Bell Laboratories in Holmdel, New Jersey. The division does research on the methods and technologies for future communication and computing, including current emphasis on lightwave systems, multiprocessor computer systems, and new physical devices for optics and electronics.

Dr. Lucky has been active in professional activities, and has served as president of the Communications Society of the Institute of Electrical and Electronics Engineers (IEEE), and as vice president and executive vice president of IEEE itself. He has been editor of three technical journals, and since 1982 he has written the "Reflections" column of IEEE's *Spectrum Magazine*.

Dr. Lucky attended Purdue University, receiving a B.S. degree in electrical engineering in 1957, and his M.S. and Ph.D. degrees in 1959 and 1961. After graduation he joined AT&T Bell Laboratories in Holmdel, NJ, where he was initially involved in studying ways of sending digital information over telephone lines. The best known outcome of this work was his invention of the adaptive equalizer -- a technique for correcting distortion in telephone signals which is used in all high speed data transmission today. The textbook on data communications which he coauthored became the most cited reference in the communications field over the period of a decade.

He is a Fellow of the IEEE and a member of the National Academy of Engineering. He is also a consulting editor for a series of books on communications through Plenum Press. Dr. Lucky has been on the advisory boards or committees of five universities and of the National Science Foundation, and was chairman of the Scientific Advisory Board (SAB) of the United States Air Force from 1986-1989. He is the 1987 recipient of the Marconi International Fellowship Award. In May 1988 Dr. Lucky was awarded an honorary Doctorate of Engineering from Purdue University. In 1989 his book *Silicon Dreams* was published by St. Martin's Press. *Silicon Dreams* is a semi-technical discussion of the forms of information we deal with in the information age.

Dr. Lucky and his wife, Joan, currently reside in Fair Haven, New Jersey. He is a native of Pittsburgh, Pennsylvania.

IIA

INFORMATION INDUSTRY ASSOCIATION

Written Statement

of

THE INFORMATION INDUSTRY ASSOCIATION

before

THE HOUSE SUBCOMMITTEE ON TECHNOLOGY

Oversight Hearing

on

FY 1996 Technology Administration Budget

March 23, 1995

Submitted by

Daniel C. Duncan

Vice President, Government Affairs

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The Information Industry Association ("IIA") appreciates the opportunity to offer comments for the Subcommittee's consideration as part of its oversight hearing on operations of agencies housed within the Technology Administration. The government's use and promotion of technology is of great interest to IIA member companies, and the Association commends the Subcommittee for examining these programs now.

Of equal importance to IIA and its member companies, however, is the manner in which the government chooses to disseminate "scientific, technical and engineering" information to the public. For that reason, IIA limits its comments for this hearing to the activities of the National Technical Information Service ("NTIS").

IIA is the trade association of leading companies involved in the creation, distribution and use of information products, services and technologies. Our 500 corporate members range from large multinationals to entrepreneurial start-ups, and include traditional and electronic publishers, database producers and providers, interactive electronic services (audio and video), computer manufacturers, software developers, financial information services, and telecommunications providers. Many of our members provide products which incorporate some information generated by government. Therefore, a federal information dissemination policy that assures a diversity of sources of government information has been one of IIA's paramount public policy goal since its founding in 1968.

The culmination of IIA's involvement in the issues surrounding federal agency information dissemination is a set of guidelines for agencies to follow in allowing access to government information and in setting dissemination policies. These principles are based on the experiences of the information industry, and in particular, IIA member companies, over the last 27 years. They have been embraced by Congress, the executive branch and the courts, because they benefit all citizens by fostering the widest possible availability of federal information from a diversified group of private and public institutions. Unfortunately, IIA has found that NTIS may philosophically and practically operate in opposition to many of these principles. If unchecked by congressional oversight, NTIS could use its current statutory authority to effectively reduce access to public information.

Information Industry Association General Philosophy Regarding Federal Dissemination of Public Information

Information has long proven to be a powerful social and economic resource. Speaker Gingrich has asserted that a citizenry well informed of congressional proposals is vital to a balanced, unbiased debate. His words reflect a view long championed by IIA. Information generated or held by government -- whether by executive, legislative or judicial agencies and officials -- is a valuable resource that provides people with knowledge of their government, society and economy. Access to such information is the sine qua non of participatory government for furthering public debate and fostering better decision-making to help accomplish both public and private goals.

The information industry has responded to this need for knowledge by obtaining government data, adding value to it and disseminating it to its customers. Thousands of private sector information products and services are based in whole or in part on public information. Information companies complement federal government information in a variety of ways: by assembling, arranging, and organizing it in useful manners; by combining it with information from other sources; by adding indices and annotations; and by updating and expanding databases to make sure that they are comprehensive, timely and accurate. Information companies then make these value-added products available to the public in convenient, useful and user-friendly formats and media, and provide ongoing customer service, including training and technical assistance. In short, a mature information industry has developed around the rich and diverse resource of federal government information.

Preserving this diversity and encouraging continuing creativity depends on a solid framework of government information policy principles. This framework has three main tenets.

First, as determined broadly by the courts and endorsed through executive branch policies, federal government information is public. The Freedom of Information Act ("FOIA") has created a broad right of access to public information. It, along with other public access statutes, provides unambiguous devices for access by citizens -- private and corporate -- to information created using their taxpayer dollars. These laws and regulations enforce the obligation on the part of government -- as envisioned by our Nation's founders -- to ensure the flow of public information between government and citizens.

A second tenet is no less important: the government shall not discriminate either in allowing access or in directly disseminating its information. To act otherwise invites discrimination and censorship, both of which are anathema to a free society

Third, government should not control how public information can be used or decide who may use it. Because the public's use of government information is a right, not a privilege, any person who has acquired public information should be free to use it, sell it, or otherwise disseminate it for any legal purpose without paying any additional fees or royalties to the government.

NTIS and the Paperwork Reduction Act of 1995

It is worth mentioning here that both the House and Senate in the past month have overwhelming adopted the Paperwork Reduction Act of 1995 (PRA) which embraces all of the principles listed above. The PRA will codify OMB's Circular A-130 which governs agency information dissemination activities by outlining both the responsibilities that agencies must fulfill and those actions from which agencies should refrain. In regard to possible discrimination by government authorities in their access and dissemination activities, the Act contains guidelines that apply when agencies themselves distribute data or when they use a third party source to accomplish this goal. The PRA would apply to private sector companies that provide dissemination services for agencies. IIA believes it should also apply to other government agencies which "stand in the shoes" of the originating agency. Otherwise the goal of the PRA, which is to help make public information maintained by agencies more available to citizens, could be jeopardized.

As mentioned previously, the House recently overwhelmingly adopted the Paperwork Reduction Act of 1995 which will codify federal agency information dissemination policies. The legislation -- which is supported by the information industry as well as consumer groups, non - profits and libraries -- outlines specific practices agencies should avoid. The bill states:

> With respect to information dissemination, each agency shall ... not, except where specifically authorized by statute[,]...establish an exclusive, restricted, or other distribution arrangement that interferes with timely and equitable availability of public information to the public; restrict or regulate the use, resale or redissemination of public information by the public; charge fees or royalties for resale or redissemination of public information; or establish user fees for public information that exceed the cost of dissemination...

Generally speaking, the restrictions embodied in this part of the PRA are necessary to ensure First Amendment values, to implement the long-standing prohibition on copyright in works of the federal government, and to encourage sound agency information dissemination policies.

These prohibitions are intended to be operative for every agency, unless the statute under which a particular agency carries out its information dissemination activities *specifically* directs a different policy. NTIS claims that its general statutory requirement that it recover costs allows it to avoid or interpret differently these prohibitions. This philosophy, and the practices NTIS has used to actualize it, are directly at odds with the principles long contained in Circular A-130 and soon to become statutory mandates. Again, any exceptions to the overarching rule that government information should be disseminated as widely and by as many sources as possible should be allowed *only* on the basis of a *specific statutory* exception.

NTIS Overview and Information Dissemination Activities

As technology brings more and improved ways to disseminate information to the public, citizens are looking increasingly to all types of sources for the information they need to function. In regard to government information, this means that users will seek data from the originating agency, another governmental or private source, and from private sector redisseminators. Therefore, government -- as an important player in developing the global information infrastructure -- must be even more cautious that it does not preclude the widest possible diversity of sources for its information.

This brings us to the concerns IIA has in relation to NTIS. As mentioned earlier, IIA is troubled both with the philosophy NTIS seems to have employed as well as with some specific practices in which NTIS appears to engage.

PHILOSOPHY

In general, NTIS appears to have adopted the philosophy that the business of government is to be *in* business. It has undertaken actions that seem to go far beyond its mandate to operate on a self-sustaining basis, and has established some operations that look surprisingly like those of a private sector, profitable enterprise. Not only do some NTIS policies stretch the boundaries of its legislative authority, in some instances NTIS is in direct opposition to information dissemination policies contained in Paperwork Reduction Act of 1995 as already passed by the House. As such, these actions threaten to impair public access to government information.

As members of the subcommittee are aware, NTIS was created and exists today strictly to collect and disseminate scientific, technical and engineering information ("STEI") which is generated by various federal government agencies. In effect, NTIS acts as a central repository for such information, which is originally collected by the agencies using taxpayer dollars in order to fulfill the essential dissemination responsibilities which are a part of those agencies' missions.

The governing statue that provided NTIS with this special role for STEI is the American Technology Preeminence Act ("ATPA" P.L. 102-245). By mandating that all federal agencies transfer to NTIS all STEI that results from federally funded research and development ATPA sought to increase American participation in technology development.

The mandate for transfer of STEI was intended to allow NTIS to become an efficient service to provide information to the American people to aid the drive for increased American competitiveness. However, NTIS' profit-making approach to its operations threatens to reduce access. Rather than fulfilling the crucial role of granting wider access to scientific, technical and engineering information, NTIS has undertaken steps that serve in some instances to forestall broad dissemination of this material and in others unnecessarily duplicate the dissemination efforts both of the private sector and other governmental bodies.

In a business-like effort to expand its inventory to make it more attractive to potential users, NTIS has adopted a very broad, 1954 Comptroller General's Opinion definition of "technical information." This broad definition creates a situation whereby the originating agencies are transferring whole classes of information to NTIS for dissemination and in some cases then refusing to provide it directly to users. The problems associated with this refusal are discussed further throughout the testimony.

The lack of a sharply-focused statutory definition has also resulted in NTIS' duplication of existing government information collection and dissemination efforts -- namely those of the Government Printing Office ("GPO"). This is precisely why Congress, as a condition of granting NTIS an FY 1995 appropriation, tasked NTIS with working with the GPO to eliminate this duplication.

PRACTICES

Exclusive Arrangements: The purpose for restricting agencies from entering into exclusive information dissemination activities is to ensure that no agency, private company or other non-governmental entity can establish monopoly control over public information. Public information should be available to all. As the U.S. Court of Appeals for the Second Circuit has stated: "The evils inherent in allowing government to create a monopoly over the dissemination of public information in any form seem too obvious to require extended discussion."

Nonetheless, in an effort to promote its joint venture opportunities, NTIS has suggested in at least two publications that an exclusive arrangement for information dissemination might be made. In its two-year business plan produced in 1992, NTIS stated: "[T]he joint venture program enables NTIS to enter into *exclusive* non-competitive partnerships with private sector organizations to invest resources and share benefits." In its 1993 joint venture guidelines, NTIS wrote:

"[C]ompanies making investments to enhance NTIS information products and services may also need *exclusivity* to warrant their level of investment and to ensure that they can capture some benefit from their investments."

__Restrictions on Redissemination:__ If an agency *can* disclose government information, then an agency *should* disclose it. To ensure the free flow of information afforded by the First Amendment, governmental authorities should not restrict or regulate the use, resale or redissemination of public information. Unless the government can justify restricted access to its information under tightly controlled procedures to protect national security, no legitimate governmental purpose can be served by limiting the use of government information.

Copyright statutes are a means for originators of information to assure the value of their data and to protect against its misuse through restrictions granted to the owner of the information. However, in the United States, Section 105 of the 1976 Copyright Act expressly prohibits, with very limited exceptions, federal government assertion of copyright in its works. This prohibition exists both to prevent a surreptitious means by which government might seek to control information about itself and to protect the First Amendment guarantees of freedom of speech and press.

Yet, despite the long-standing acceptance of Section 105 of the Copyright Act, NTIS continues to enforce copyright-like controls over the information it has available. Last year NTIS offered to provide the bibliographic database which it creates and maintains to Depository Libraries at no cost. Acting like a profit-making business rather than a governmental agency, NTIS issued regulations which placed copyright-like, downstream use restrictions on the information. The regulation stated: "[I]mproper disclosure of this valuable information could seriously erode NTIS' ability to operate on a self-sustaining basis... [I]mproper dissemination of the list of products could significantly reduce the rental value of NTIS's bibliographic database as an income producing asset."

Another more permanent and long-term example of NTIS' prohibitive dissemination practices is shown through the evolution of its contracting agreements over the past 25 years. Throughout the 1970's and most of the '80's, NTIS' database user contracts consisted of approximately seven pages of text and several schedules. Today, in contrast, NTIS employs a private sector, copyright-like license agreement which consists of 18 pages of text and was adopted -- according to one of IIA's member companies -- from perhaps the single most restrictive database copyright license agreements utilized anywhere in the world.

Royalties: Governmental imposition of royalty fees for resale or redissemination of publicly available information represents another copyright-like control over data and as such violates OMB A-130. Again, the Copyright Act's limitations on the government's ability to copyright public information confirms the premise that any person who has acquired the information may use it, resell or redisseminate it without paying any additional fees or royalties to the government.

The bibliographic databases mentioned in the example above are the NTIS products most often used by the information industry in its information products. Again, these databases are created from information that agencies are mandated to give to NTIS under the ATPA -- agency information that is created at taxpayer expense. Yet, anyone in the public wishing to use this information must enter into a licensing agreement with NTIS that requires a payment of a flat fee and payment of an additional royalty fee based on the amount and frequency of use of the information.

Over the years, the royalty rate and other downstream use restrictions in NTIS' licensing agreements have steadily increased - so much so that in some instances information companies are contemplating abandoning the information. Thus the goal of increasing American participation in technological developments has the potential to be seriously undermined, as NTIS policies force competing private sector participants to reduce either the number or scope of their products and services. This is a prime example of how bad information dissemination practices defeat the primary objective of government to inform its citizens through wide dissemination of information.

User Fees in Excess of Cost of Dissemination: A practice that some agencies employ that looks suspiciously like the controls granted exclusively to non-government owners of copyrighted materials is the imposition of a fee that is based on market value rather than the cost of dissemination. Copyright owners operate in a competitive marketplace, and their investment in creative and innovative materials can continue only if they receive fair compensation for their goods and services. However, government must and should act differently in a free and open society. To encourage the widest possible dissemination of public information, agencies should make their information available at the cost of dissemination -- that is the cost of making a copy available in the format requested by the user. FOIA, for example, limits agencies to recovering only the "direct costs" of searching, duplicating, and reviewing records found to be responsive to a request.

Based on the notion that its mission is to disseminate information, and that it is to be self-sustaining, NTIS argues that *all* of its costs should be included in the cost of dissemination and thereby charges high fees for obtaining information. Moreover it appears to add more costs on high-volume, popular information. In some instances the user has no lower-cost option for obtaining the information because the originating agency believes it is fulfilling its dissemination obligations through NTIS.

NTIS as a Fee-Funded Agency

While the previous comments have been restricted to problems relating to information dissemination activities, it is also important to note here concerns relating to the fact that NTIS is a fee-funded agency.

Normally when an agency collects fees for the dissemination of information, the revenues go into the U.S. Treasury. If an agency wants to establish a dissemination activity, it must justify it to Congress, which in turn will appropriate the funding only after it deems the agency request necessary and justified. This process provides an opportunity for Congress and the public to examine the proposal as it relates to the agency's mission as well as its relation to other dissemination activities in the public and private sectors. However, Congress yields some of its important oversight role and reduces the agency's public accountability when it authorizes fee-funded dissemination operations.

When an agency is funded directly from collected fees -- as in the case of NTIS -- it has an incentive to generate fees even if it means disregarding long established and widely supported information dissemination policies. One example of NTIS' disregard of dissemination policies has the potential to roll back a very important method of obtaining information -- FOIA requests. NTIS is marketing itself to agencies as a new means for fulfilling FOIA requests. Because it is fee-funded, NTIS is not obligated to return fees in excess of cost of dissemination to the Treasury. Thus, NTIS can charge much higher fees for fulfilling the request and keep all of the revenue generated.

Because FOIA requests are viewed as a burdensome process by some agencies, they are all too glad to turn over their responsibilities to NTIS, in effect making NTIS the de facto FOIA disseminator. This practice is contradictory both to FOIA and to PRA, and it has the potential to create a bureaucratic nightmare as a potential user of information is sent by the agency to NTIS for the information only to find the cost at NTIS is prohibitively high. This "FOIA-for-profit" process is antithetical to the purpose and promise of FOIA and will ultimately lead to less public access to government information.

Conclusion

In 1822 James Madison wrote, "Knowledge will forever govern ignorance, and people who mean to be their own Governors, must arm themselves with the power knowledge gives." A cornerstone principle of the American democratic tradition has been disclosure of government information in a timely and cost-efficient manner so that citizens can make informed choices. In order to accomplish this goal, government, the private sector, and citizens at large must all participate in the process of obtaining and disseminating information about the functioning of society. Over the course of our Nation's history, a balance between the roles of these three parties has been established which has made the United States the most open and best-informed country in the world.

IIA, as the primary representative of private sector providers of publicly-held information, has worked continuously to assure the existence of a competitive and diverse marketplace for all information, including that generated by government. We believe Congress and the executive branch is committed to remaining vigilant in assuring that government information continues to be widely accessible and that it is disseminated by agencies in a timely, fair and equitable manner. IIA commends the subcommittee for holding this important oversight hearing and urges the members of the subcommittee to review the information dissemination activities of NTIS against the backdrop of long-established American traditions.

THE UNITED STATES RESEARCH & DEVELOPMENT CAPACITY

The Advanced Technology Program and the Health Information Infrastructure

Testimony to
the U.S. House of Representatives
Science Subcommittee

C. Everett Koop, M.D.

Senior Scholar
The C. Everett Koop Institute at Dartmouth

March 29, 1995

INTRODUCTION

Madam Chairwoman and members of the House Science Subcommittee, it is a great pleasure to have this opportunity to testify before you about an issue that is so crucial to the health of our nation in the decades to come.

My name is C. Everett Koop. I am a physician with 40 years experience of helping patients, an academic, and have known the pleasures and pitfalls of being deeply involved throughout the 1980s and the 1990s in developing policy surrounding science and the health of Americans. Many of you probably know me most for serving as the Surgeon General under two Republican presidents.

Since leaving active public life, I have been deeply engaged in acting as a catalyst to corporate America's capabilities for the purpose of improving the health of Americans. I am a Senior Scholar at the C. Everett Koop Institute at Dartmouth and hold an endowed chair at Dartmouth Medical School. The Koop Institute has been involved in stimulating the growth of the health component of the National Information Infrastructure, because this health information infrastructure (HII) is quickly becoming a central organizing mechanism for market-based health care reform. The Koop Foundation, of which I am President, has acted as a nonprofit broker and convener for eleven leading American corporations (i.e., AT&T, Booz-Allen & Hamilton, Inc., the Corporation for Studies and Analysis, D. Appleton Company, Inc., Logicon, Meta Software, Oracle, Science Applications International Corporation, Systems Research and Applications Corporation, Western Consortium for Public Health, Wizdom Systems, Inc.) who have formed a joint enterprise and contributed over $15 million of their own resources toward building some of the underlying pre-competitive tools providing some of the crucial foundation stones of the health information infrastructure. The $15 million in private sector funds have been matched with almost $15 million in ATP funds from the National Institute of Standards and Technologies (NIST).

Without the HII, our fledgling market-based health care reform will be without a "nervous system." Without this nervous system, we will neither have the data necessary to evaluate the changes taking place in the health marketplace, nor will we have the private or public sector mechanisms in place to make the subtle changes essential to accomplishing successful market-based reform. Without successful market-based health care reform, it is the belief of many private sector leaders that a government-run national health care plan becomes far more likely. I believe that a government-run health care system would inhibit innovation and unnecessarily lower the quality of health care. It would diminish the personalized attention of a physician -- a priority in the recent health care reform debates. It is for these reasons that I believe the Advanced Technology Program is so important. It will encourage and enable key private sector players to join together to build the high risk pre-competitive technological underpinnings of the nascent health information infrastructure that is becoming so important to the health of our nation and its citizens.

THE IMPORTANCE OF PRE-COMPETITIVE R&D

1) R&D is the life blood of our future information-based economy.

2) If we had to choose between government and private sector R&D, there is no choice. R&D needs to be primarily a phenomenon of the private sector.

3) The Koop Foundation, for example, is convening the HII Consortium engaging approximately 60 of the largest companies in health care, telecommunications, computing as well as some of the nation's largest employers. The Consortium participants are identifying the key issues and strategies needed for building the health component of the information infrastructure in order to empower market-based health care reform.

4) We do not have to, nor should we, choose only private sector R&D if it means that our nation's R&D base would be jeopardized. The government has a legitimate role in aiding the private sector in developing pre-competitive technologies that stimulate the emergence of the market. This is especially true in instances where the technology base requires many technology leaders -- who are, by nature, competitors -- to form common standards and platforms, for example, interoperability and interconnectivity.

5) The growth of the HII will be stifled without pre-competitive R&D in the area of the Health Information Infrastructure, which programs like ATP are designed to stimulate and appropriately engage the private sector in the building process.

6) The result of crippling the private sector's engagement in pre-competitive R&D, by substantially eviscerating the ATP effort in this area would damage the foundations for properly carrying out and monitoring the fragile market-based health care reform that has begun to emerge.

7) The negative consequences of reducing the ATP funds would be significant on the private sector and the public. For example:

> 7.1) technology companies would not be delivering the necessary enabling technology.
>
> 7.2) the health sector would not be able to utilize the technology to improve the quality and access to care at a lower cost.
>
> 7.3) employers would continue to pay exorbitant prices for health care. They would need to cut down on the number of jobs or benefits not only to the presently employed, but also the retiree population.

7.4) This would generate more costs to government through unemployment, Medicare and Medicaid expenses, as well as further strain the health reserves of the public at a time when we need to be thinking about how we should be strengthening our nation's intelligent human resources in an era of stiffening global competition.

ADDRESSING COMMON MISCONCEPTIONS REGARDING THE ATP

* Is the ATP necessary?

Yes. Without the Advanced Technology Program, the foundations of the health component (as well as other components) of the National Information Infrastructure are in jeopardy. The ATP is especially critical at this time when we realize that the future vitality of our economy is dependent upon world leadership in our information sector, yet the National Information Infrastructure is nascent and the lack of infrastructure is inhibiting the information and technology markets.

* Does the ATP promote R&D that is particularly useful?

Yes. In the case of the health information infrastructure, the ATP is one of the few mechanisms for stimulating high risk pre-competitive R&D. This R&D is essential for building the health informatics marketplace that will enable, for example: the transmission of a universal electronic claims structure; interoperable computerized patient records nationally; telemedicine into rural and inner city areas; the delivery of consumer health information via interactive digital video; community networks; and the aggregation of chronic disease data on a state-by-state basis and nationally for more effective disease surveillance and epidemic and crisis management.

* Is the ATP corporate welfare?

No. The welfare connotes a support net for those needing assistance, and has come to mean in many people's eyes a process that weakens, seeding a dependency relationship. The ATP has no resemblance to welfare in that it encourages innovation on the basis of strength and private sector contribution. Although large companies are ATP award winners, most of the awardees are small companies, like in our own joint venture.

The ATP requires that the private sector participants receiving awards provide the majority of the funds for the proposed R&D. As a result of these companies having substantially institutional resources on the line, they have a strong interest in ensuring that the outcomes of the R&D effort will some day be commercializable. If or when the outcomes of the high risk ATP R&D are brought to market, these companies generate jobs and profits. They then pay back to the government, the value of the ATP contribution many times over in the form of corporate income tax.

* Is the ATP another example of the government trying to pick winners and losers?

No. Again these companies have generated their own proposals based upon their own interests in some day commercializing the outcomes of the research. However, the nature of the high risk pre-competitive R&D is that it tends to stimulate broad market growth. For example, without some of the HII tools and methods slated for development under the ATP, not only the awardees but a broad set of health informatics contributors lose because the markets dependent upon these tools and methods as catalysts will remain dormant.

* Is ATP enabling R&D that would not otherwise be done by the private sector?

Yes, in many ways. I will mention two examples: 1) the ATP provides an environment for competitors to come together to resolve technical and market problems that any one company can not solve on their own (e.g., interoperable tools, methods, repositories, and communications networks); 2) in the health sector, it is widely understood that a consumer enabled by health information would be a judicious consumer of health care. However, the existing market for consumer health informatics is greatly hindered by present market dynamics and the lack of appropriate tools, applications, and interfaces. The ATP is enabling several major technology and health sector companies to make investment in this area whose payoff will be enormous for the companies, the public, and the nation, yet is beyond the horizon of most corporate R&D.

* If these R&D activities are so important, then why is the private sector not able to do it on their own?

The pressures of serving the short term interests of stock holders tend to make corporations risk averse and short sighted. Corporate myopia tends to strengthen quarterly returns for awhile. However, we have witnessed the negative impact of this short sightedness in the decline of some of America's premier institutions (e.g., IBM) as well as in the loss of our leadership in manufacturing in 1970s and 1980s.

Pre-competitive, high risk R&D has for the past three decades has been dependent upon government investment. This pre-competitive phase is a crucial part of the natural history of research and development. The eventual commercialization of the R&D products depends upon it.

Now, after the cold war, there are compelling reasons to directly seed R&D through mechanisms like ATP when military mission-specific R&D is on the wane. In a world where other nations are seeding R&D for the domination of 21st century markets, our national security and way of life is as much dependent upon our private sector's pre-competitive technological and economic capabilities as on the still massive military R&D capacity. If we as a nation are suffering more in one of these two critical areas, it is clearly in our ability to deliver competitive products to domestic and international markets as witnessed by our trade imbalance and the sagging value of the dollar.

* Where is there evidence of government programs like the ATP program having strengthened the American R&D base and its stature internationally?

The U.S. government's investment in R&D has paid tremendous dividends in terms of our global leadership militarily. This was demonstrated unequivocally to the world during the Gulf War. Now, as we are emerging from the shroud of the Cold War, there is even more reason for the U.S. government to invest in pre-competitive research and development because our well-being and leadership as a nation is so dependent upon our economic and intellectual excellence in comparison with other nations.

Other nations are clearly beginning to out spend the United States in nonmilitary R&D and the evidence of the impact on the American economy is compelling. The European Union is building a strong health informatics initiative with over a billion ECUs (more than a billion dollars) of the EC's governmental resources going toward their health information infrastructure. These governmental R&D investments are matched with private sector European investments in the same way the ATP requires the majority of resources being committed by American private sector firms. In short, the message is that without programs like the Advanced Technology Program, communications and other sectors, from which we have enjoyed the fruits of leadership, will fall behind other nations as our manufacturing base did in the 1970s and 1980s.

Suprizingly, a striking example of where this type of public/private investment in information technologies (in this case, European) is paying off for the health of Americans is with American GIs in Europe. American soldiers in Europe are beginning to carry EC smart cards that enable them to bring their medical records and eligibility information with them everywhere they travel in Europe. This capability is not available in the United States due to the lack of smart card technology and associated information infrastructure available in the United States.

- Why not tax credits vs. the ATP program?

  Although tax credits sound attractive, splitting the modest amount of ATP dollars throughout the private sector would diminish the leverage of HII R&D to zero. Unfortunately, it would also be very difficult to enforce the R&D tax credits going toward high risk, pre-competitive R&D. Corporations would naturally tend to use R&D tax credits for shorter term, less risky and, therefore, lower leverage R&D that would be far less helpful in building our country's health information infrastructure. The ATP uniquely prepares the United States for facing the challenges of global competition in the decade ahead -- through strengthening the pre-competitive foundations of the National Information Infrastructure.

CONCLUSION

We must prepare our nation for a 21st century information-based economy. Intelligent human resources are critical for our future success as a nation. Unless Americans are healthy, our nation's human resources will suffer. The quality and access to affordable health care is crucial to the health of Americans as is their access to new information-based health services. In order to improve the likelihood of market-based health care reform succeeding, the United States must build a viable Health Information Infrastructure (HII).

Without a viable HII, the estimated $100 Billion interactive health information market will not emerge. American jobs will suffer. The health of the American public will be unnecessarily compromised. Our nation's intelligent human resources will be weakened. The United States, under this scenario, will not be properly poised for global leadership in the next decade and beyond. It is for these reasons, that I recommend that the funds for the Advanced Technology Program be protected from unnecessary cuts that would compromise our nation's pre-competitive R&D.

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FOLLOW-UP

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ITEMS: C. Everett Koop Testimony

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Testimony of David B. Singer
Committee on Science Subcommittee on Technology
TA/NIST Budget Authorization Hearing - March 23, 1995

My name is David Singer and I am President and Chief Executive Officer of Affymetrix, a two-year old, 75 person biotechnology company headquartered in Santa Clara, California.

Our mission is to develop technologies which enable scientists and doctors to analyze genetic information faster and more cost-effectively than current technologies allow. The ability to understand complex genetic information rapidly is becoming critical as the human genome project becomes a reality. This new knowledge of the genetic basis of disease will play a critical role in increasing the efficacy and decreasing the cost of healthcare, especially in areas such as cancer and infectious and genetic diseases.

Our core technology is a unique marriage of manufacturing techniques used by the semiconductor industry and advanced biochemistry which has served as the foundation for the biotechnology industry. This combination of technologies allows us to manufacture chips with DNA molecules on them for sequencing DNA. These chips have broad applicability in basic research as scientists elucidate the relationship between human genes and disease. Once these relationships are established, the chips will provide a cost effective tool for clinical diagnostics.

As a small company, we must use our resources to bring our first generation products to market. Our first product is a tool to analyze the HIV virus in AIDS patients so that physicians can combat drug resistance (a major expense in AIDS treatment) through the use of more appropriate drugs. At the same time, our scientific team has conceived of future generations which will increase the power, and thus the market opportunity, of our technology. We do not have the resources to develop them now. More specifically, these ideas could make the technology more useful to less-sophisticated users in doctors' offices, small hospitals and clinics. This concept is at the heart our of ATP grant research effort.

It is within this context that we decided to compete for an award in the Advanced Technology Program. Our efforts began in the winter of 1993-94 as we submitted a "White Paper" to NIST supporting "DNA Diagnostics" as an appropriate sector in which to have a competition. In the spring of 1994, when NIST announced that there would be a competition in "DNA Diagnostics" we increased our resource commitment at Affymetrix (1) to establish a consortium of the necessary expertise: two for-profit companies, four universities, and a National Laboratory and (2) to formally compete to win the award.

In October of 1994, our consortium was awarded a $31.5 million grant, which we have to match with an additional $31.5 million, to pursue feasibility of the ideas discussed above. This award is not only subject to our providing the matching funds, but also to annual Congressional appropriations and quarterly and yearly reviews by NIST and its external advisors. Our five-year goal is to demonstrate the feasibility of the technology so that we can begin the far more costly process of product development.

For a start-up company, we are doing fairly well, so I don't want to give you the impression that we would not exist without this grant. However, in the absence of additional external funding, we will not pursue these long-term, high risk technology developments.

Unfortunately, we can not afford to pursue these important ideas because every time we make decisions about allocating our limited resources, we decide to spend money on products which will produce revenue in the next three years, not those "high-risk, pre-competitive" initiatives which will be critical for the next decade. The capital markets, whether public or private, demand to see product revenue in the near-term. Even the most long-term investors -- venture capitalists -- have, at best, a five-year time horizon.

There are a number of points I believe that this committee should consider as it evaluates the ATP program:

* The ATP funds pre-competitive, high-risk basic technology development through a rigorously run competitive process which is a model for cost-shared, industry-led partnerships. Our partner, Molecular Dynamics, a newly formed public company, is testimony to the fact that the public capital markets simply will not fund projects of this magnitude and time-scale. In fact, these are technology development programs whose time horizons exceed the investment appetite of venture capitalists.

* Technology has radically changed the global economy in every industrial sector and we must acknowledge that these changes require adaptation, both in how we in industry approach our business and the way government supports American competitiveness. Private and public entities around the world are working together in novel partnerships with increasing frequency to meet the challenges.

* The Federal Government has acknowledged the importance of the human genome program in providing better healthcare for more people at lower costs. Combinations of universities, companies and government agencies are doing the same in almost every developed nation.

The human genome program is not able to support the transition of many promising technologies from basic research through pre-competitive technology development. If we want to see the benefits of the human genome project actually being used broadly in healthcare, we must fund the development of technologies which ten years from now will allow this to happen -- that is what Affymetrix and others are doing under the ATP.

* On a more macro point, the biomedical sector is fundamentally different from other sectors -- such as high-tech consumer products -- because of the time it takes to get products to market. The major driver of this "time to market"

challenge is that the government has high (costly) regulatory hurdles for companies like ours to jump over.

From the view of a small company based 3,000 miles from Washington, D.C. the encouraging part of the current debate about fiscal responsibility in Congress is the acknowledgment that we must reduce the deficit and stop mortgaging our future standard of living for current consumption -- that's ultimately the whole point of this exercise. It seems to me that a major part of being fiscally responsible is creating an environment where we as a nation are investing appropriately in our future. We have a solid history of making these types of investments years ahead of other countries -- as evidenced by our leadership position in most of the emerging technology dominated industries.

This is best illustrated by a story told to me by Stanford Professor Paul Berg, a Nobel Laureate and Affymetrix director, about a conversation he had with President Mitterand of France during a Mitterand visit to Stanford. Mitterand was admiring Silicon Valley and the American preeminence in biotechnology and was trying to understand its origins. To a stunned Mitterand, Dr. Berg replied that much of the fundamental science underpinning the biotech revolution had actually been done at the Institute Pasteur in France in the 1950s and 1960s. The reason these advances were capitalized upon in the United States was, to a large degree, a result of the federal funding for universities and small U.S. companies for basic research and pre-competitive technology development.

The list of basic advances made in the United States but commercialized by other countries because of the inability of the capital markets to fund their "pre-competitive" stage is long and sad, including VCRs, memory chips, small copiers and fax machines. Today, the ATP approach and other initiatives focused on basic science serve as a model for similar initiatives in virtually every developed country.

Even with an imperative of deficit reduction, we should ask where, to the extent the Federal government is making investments, do those investments enhance productivity and, thus competitiveness? In lay terms, a key test of any investment is: "Does it help the Nation deal with the deficit in the future?" From an operating company's perspective, debt-financed investments must yield returns greater than the cost of the debt -- otherwise, it would be a financial disaster.

The evidence is irrefutable that investments in high-risk pre-competitive technology enhance productivity over the long-run. Therein lies the importance of the competitively decided, cost-shared ATP awards.

PROGRESSIVE POLICY INSTITUTE

April 5, 1995

Representative Connie Morella
Chair, Subcommittee on Technology
U.S. House of Representatives Committee on Science
Washington, D.C. 20515

Dear Madame Chairperson:

Attached is a statement I would like to submit for the record regarding the NIST authorization. Thank you.

Sincerely,

Robert J. Shapiro
Vice President

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PPi
PROGRESSIVE POLICY INSTITUTE

Statement of

Robert J. Shapiro

Vice President, Progressive Policy Institute

U.S. House of Representatives Committee on Science

Subcommittee on Technology

March 23, 1995

Madame Chairperson, I am Dr. Robert J. Shapiro, Vice President of the Progressive Policy Institute and director of economic studies of the Progressive Foundation. I appreciate this opportunity to present the views of the Progressive Policy Institute concerning the Federal government's proper role in supporting investment in technologies that directly benefit the private sector, specifically the Advanced Technology Program and the Technology Reinvestment Project.

Some Members of this committee may be familiar with the Progressive Policy Institute's (PPI) strategy for fiscal-policy reform, as explained in my report *Cut-and-Invest: A Budget Strategy for the New Economy.* The current debate over eliminating or reforming subsidies for particular industries—so-called "corporate welfare"—originated with this and earlier PPI reports; and many other organizations in Washington, from the liberal Center for Budget

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and Policy Priorities to the libertarian Cato Institute, have endorsed our approach to subsidies. *Cut-and-Invest* details savings of $265 billion over five years that could be produced by ending or reforming 120 special spending and tax subsidies that today reduce the U.S. economy's efficiency and productivity.

The proper goal of budget reform should be to ensure that American workers and firms have the means to be more productive and competitive in the global economy. To accomplish this, we must cut the deficit so that *private* investment can increase more rapidly, while simultaneously expanding *public* investments in the factors of production common to all economic activity—worker education and training, basic research for new technologies, and transportation and communications systems that link firms and customers to markets. These public investments are designed to address areas of classical "market failure," where private investment does not generate the activity necessary for an economy to optimize its potential. PPI's proposals would redirect to deficit reduction and thus private investment 57 percent of the savings from ending subsidies, while another 24 percent of these savings would go to public investment, and the remaining 19 percent could be targeted tax relief for moderate-income families with children.

The success of this strategy depends on both maintaining a clear distinction between public investment and other government spending, and recognizing subsidies when we see them.. True public investment differs from other government spending in two important ways. First, its only purpose is to expand the private economy's future capacity to create wealth and generate mass upward mobility. Second, it is called for only in those areas where markets invariably fail to generate appropriate levels of private investment—education and training, basic research, and economic infrastructure, in the areas of, respectively, human, technological, and physical capital.

In *Cut and Invest*, I include as subsidies which should be reformed the Advanced Technology Program and the Technology Reinvestment Project. Both programs help support scientific and technological research, but raise serious questions for market-based fiscal policy when they cross the line from supporting basic research, a proper focus of public investment, and begin to subsidize commercial development by a particular firm and industry. The tasks of converting discoveries in basic research to products with commercial potential, and assisting in moving these new products to the marketplace, should be assumed by the market, not by taxpayers who will not share in the profits. Once again, if commercial firms see potential profits from risky development activities, the firm—not the taxpayer—should assume the risk.

Having said that, let me add that in some instances, support provided through the Technology Reinvestment Project can be justified on national security grounds. We should always be skeptical of government spending programs or tax provisions that single out a particular industry and artificially elevate its rate of return through such measures. To the extent that the programs under question serve an overriding social purpose such a national security, or direct their support to basic and generic research, their expenditures may be justified.

One final point: The cut-and-invest fiscal strategy *does* support private technological investment—but not through industrial-policy subsidies and interventions. Rather, it would reduce the cost of capital by cutting the deficit, enabling firms to undertake investments they otherwise could not afford; and it would increase the supply of workers adept at operating and maintaining sophisticated technologies by expanding support for education and training. For a market-based economy like our own, this approach, along with support for basic research, should produce the best results.

The American Society of
Mechanical Engineers

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STATEMENT ON
INTERNATIONAL STANDARDS AND TRADE

SUBMITTED BY THE
COUNCIL ON CODES AND STANDARDS
OF THE
AMERICAN SOCIETY OF MECHANICAL ENGINEERS

BEFORE THE
SUBCOMMITTEE ON TECHNOLOGY AND COMPETITIVENESS
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

MARCH 4, 1992

Mr. Chairman and Members of the Subcommittee:

ASME is a nonprofit educational, scientific and charitable organization that was founded in 1880 and now has over 119,000 individual members including nearly 19,000 student members. ASME has no corporate or organizational members; therefore, it is not in competition with any organization for company member dues.

A Board of Governors, elected by the membership, manages the Society. The Board of Governors has assigned the duties associated with the operation of codes, standards, related accreditation and certification programs to the Council on Codes and Standards (CCS). This Statement reflects the views of that Council.

The Role of Standards

Since 1884, ASME has served the public through its codes and standards programs. The original Power Test Codes developed by ASME were intended to provide a basis of criteria for power equipment. The term code was used to reflect the intended use of the document as part of contractual arrangements. When ASME organized the Boiler and Pressure Vessel Committee, it was for the purpose of reducing the number of boiler explosions occurring at the turn of the century. The Boiler and Pressure Vessel ("B&PV") Code has been referenced in the regulations of many States, Municipalities and Federal Agencies. The States and Municipalities enforce the BP&V Code.

Today, ASME is one of the world's largest voluntary standards-setting organizations. ASME codes, standards and related accreditation and certification programs involve 122 projects with approximately 600 codes and standards and 10 accreditation and certification activities. ASME standards run the full range of products and systems - from boilers to pumps to valves. Approximately 4,000 volunteers develop ASME's codes and standards and serve on the committees addressing codes, standards, accreditation and certification.

After a standard has been thoroughly considered and approved by an ASME committee, it is referred to the American National Standards Institute ("ANSI"), for acceptance as meeting the criteria for an American National Standard. ASME is accredited by ANSI to develop American National Standards.

ASME Involvement in International Standards

As early as 1898, ASME was involved in international standards for testing materials. When ASME began developing performance test codes and criteria for testing materials, businessmen and engineers had no recognized baseline against which to write a purchase order nor an institution through which to participate in international standards. From this early involvement in domestic and international standards, ASME participated in the formation of such organizations as the American Society for Testing and Materials ("ASTM") and, in 1918, ASME joined with the other four major engineering technical societies in organizing and founding the predecessor organization of the American National Standards Institute.

Although ASME has been involved in developing international standards for more than 90 years, the United States Government showed little interest in codes, standards and related accreditation programs until the Kennedy Rounds of the GATT tariff discussions. And this interest stemmed from the Treaty of Rome and Europe's interest in the removal of tariff barriers. During those discussions, it was alleged that ASME's B&PV Code symbol stamp certification program was a "non-tariff" barrier because ASME limited its program to manufacturers located in the United States of America and Canada where the ASME Code was adopted as a means of satisfying State, Municipal and Provincial regulatory requirements. Although several States of the Unites States had a "State Special" or equivalency provision in their regulations, it was alleged that the "State Special" was more difficult to obtain and presented a non-tariff barrier. As a result, the United States sued ASME under the Sherman Antitrust Act. The suit was settled with a Consent Decree that provided, in part, for ASME to expand its accreditation from North America to the rest of the world.

Since 1972, ASME has administered its accreditation program uniformly about the world and has accredited manufacturers in more than 42 countries. Through the surveillance provided for in the Consent Decree, ASME looks upon the United States as the host government and through this relationship receives counsel on international matters that involve ASME consultants, designees and inspectors that are part of the infrastructure of a worldwide accreditation program. However, ASME recognizes that Consent Decrees should have a finite life and that there needs to be a permanent means established by the U.S. Government to provide assurance for a U.S. conformity assessment organization.

During the early part of the last decade, ASME's CCS, in its Strategic Plan, recognized that the world is moving toward a global economy which will change the marketplace and need for standards. Some of the domestic codes and standards that have become de facto international standards will be adopted by the international standards organization(s) and other domestic standards will be pre-empted by the international version. Our Strategic Plan states, "Where ASME domestic codes and standards are pre-empted by international standards as evidenced by little or no demand for the domestic code(s) or standard(s), the Society, through technical advisory groups, will continue to support the international activity and may disband the domestic standards activity." The Strategic Plan continues, in part, "Domestic standards committees that are replaced by technical advisory groups will be funded by government, industry and the public." This funding requires government participation not now provided for in the United States, but which is common in other industrialized nations.

THE NEED TO IMPROVE THE PROCESS OF STANDARDIZATION THROUGH RESTRUCTURING

The CCS agrees with the Office of Technology Assessment that there is a need for new organizational arrangements and restructuring of standardization programs within the United States. Indeed, the CCS has been asserting this position for several years now[1], both because of existing problems in the current domestic organization interrelationships and because of the need for U.S. Government involvement in order to effectively interface on the international level. In addition, specifically as these concerns relate to ongoing negotiations with the European Economic Community about harmonization of standards and conformity assessment, ASME in the past year has begun forging new organizational relationships with the U.S. Government which, at least in part, may provide a useful model for overall structural reform.

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[1] See, e.g., April 3, 1990 Statement on "Improving U.S. Participation in International Standards Activities" Before the National Institute of Standards and Technology, U.S. Department of Commerce; June 19, 1990 Statement on "The Federal Role in International Standards" Before the Subcommittee on Science, Research and Technology of the U.S. House of Representatives' Committee on Science, Space and Technology.

In general, the present participation of U.S. voluntary organizations in the international arena lacks strong leadership, is loosely structured and has limited effectiveness. The American National Standards Institute ("ANSI") at present serves as the U.S. member of international standards organizations such as the International Organization for Standardization ("ISO"), the International Electrotechnical Commission ("IEC") and Pacific Standards Congress ("PASC"). As such, ANSI controls the activities involved in U.S. participation in these groups and sometimes inhibits the communication of U.S. Technical Advisory Groups' positions to organizations like ISO. In addition, as we have learned in connection with negotiations with the European Community, ANSI cannot effectively represent U.S. interests in a forum where government-to-government communication is necessary.

A. ANSI Is Not The Answer

There are many reasons why ANSI is not the answer either in terms of restructuring of domestic organizational relationships or effective representation of U.S. interests on an international level. And, these do not, in our view, involve ANSI's role as a "bookseller" as stated in the Office of Technology Assessment Report. Indeed, ASME does not object to standards sales by ANSI, but it has gone on the record as strenuously opposing an ANSI-U.S. Government Memorandum of Understanding which would cede to ANSI greater responsibilities and formal Government recognition of its coordinating role.[2]

To put this matter in perspective, recall as noted at the outset that ASME joined with the other four major engineering technical societies in organizing and founding the predecessor organization of ANSI in 1918. ASME still is a member of ANSI and actively participates in its activities. ASME's Associate Executive Director, Codes and Standards, has served on ANSI's Executive Standards Council, International Standards Council, and Executive Committee of the Organizational Member Body Council, and has chaired a Special Committee of the Board of Directors on the Structure and Purposes of ANSI. Nevertheless, in our view, ANSI has not always been able to provide the necessary forum for unbiased objectivity because of the vested and often conflicting interests of its membership.

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[2] See, e.g., October 24, 1991 ASTM letter to Under Secretary of Commerce White, and accompanying Report; see also October 11, 1991 letter to ANSI opposing its intent to expand its coordinating role to include accreditation activities as reflected in ANSI's proposed new By-Laws.

Increasingly during the past two decades, there have been situations where dominance of ANSI by single interest groups, generally trade associations or a major corporation, have prevented the United States from having American National Standards in some areas that are vital to health, safety and resources. In addition, because American National Standards are often the basis for participating with international standards groups, the lack of an objective forum for consensus sometimes has prevented the United States from having an effective voice in developing international standards.

It is ironic, indeed sad, that ANSI has evolved from its founding by the five major engineering technical societies into being more of a trade association for dominant, single interest trade associations. With the establishment of provisions for ANSI recognition of standards development committees within accredited organizations, such as ASME, along with ANSI's retention of the flawed "canvas method" of developing standards, the standards "marketplace" has been distorted through the outdated concept of ANSI "coordination."

In addition to "coordination" of standards, ANSI's revised By-Laws and proposed Memorandum of Understanding between it and the U.S. Department of Commerce provide for ANSI accreditation of conformity assessment administrative organizations. ASME's CCS has strenuously opposed ANSI becoming involved with accrediting organizations that administer accreditation programs. With the proposed expanded ANSI role, it can be expected that, as has occurred in the "coordination" of standards activities, dominant bodies within ANSI will be in a position to identify particular organizations acceptable to them to provide accreditation or conformity assessment services. With that approval power, the body within ANSI which has the greatest financial resources can dominate the field. The CCS does not object to fair competition, or even industry subsidies favoring a competing accreditation body; however, the CCS objects to ANSI being put in a position to determine the market which ASME can serve. Furthermore, with ANSI attempting to "coordinate" accreditation within the United States, can organizations such as ASME, which provide accreditation services in many countries, expect that ANSI's efforts in this field will lead to other bodies' similar efforts to "coordinate" such activities in other parts of the world?

Moreover, for several decades, ASME has voiced concern about the lack of true "due process" afforded by ANSI procedures and practices. ANSI's proposed new By-Laws give no indication that ANSI intends to remove the opportunity for dominance and provide for objectivity. ASME has attempted to work with ANSI over many years with the objective of improving "due process" for all users of the American National Standards system. In fact, a senior ASME staff person chaired an ANSI Committee on the Structures and Purposes of ANSI; this was a "balanced committee," having representatives from industry, technical societies, government and labor. That balanced committee made many recommendations, but ANSI's Board of Directors accepted only part of the Report. The most significant parts which were ignored by ANSI's Board of Directors would have phased out the flawed "canvas method" and provided for objectivity among parties at an ANSI appeal hearing, thus, providing for true "due process."

While ASME has continued to work with ANSI to address these concerns raised by ASME and other technical societies -- meeting with an ANSI Blue Ribbon Committee as recently as November 13-14, 1991 -- we are not optimistic about their satisfactory resolution. And, as ASME informed ANSI at the outset of those November 1991 meetings, absent resolution ASME is considering withdrawing from ANSI altogether and dissolving the long standing working relationship between ASME and ANSI -- a step which already was taken years ago by ASTM, another of the five founding technical societies of ANSI's predecessor.

In sum, ANSI is not the answer.

B. There Is A Need For An Enhanced U.S. Government Role in International Standards Activities

The ASME's CCS believes that there is a compelling need for an enhanced U.S. Government role in international standards activities both to support adequate levels of participation by U.S. technical interests and to represent U.S. private sector interests in government-to-government negotiations. Reasons why government needs to be more involved in these aspects of international standards development are illustrated by ASME's experiences in international standardization activities.

First, ASME has sponsored the U.S. Technical Advisory Groups ("TAGs") to ISO and IEC committees when ASME has administered the interfacing domestic code or standard committee with the same or a similar scope as that of the international committee. From ASME's experience with international standards, there appears to be little likelihood that industry will provide the necessary financial support to the TAGs administrator or to the qualified people necessary to represent the U.S. on the TAGs. Therefore, U.S. Government financial support will be needed in order to assure that U.S. interests continue to be properly represented in a period of greatly increased preemption of domestic standards by international standards.

Second, when international standards harmonization efforts involve international negotiations, it is essential that the U.S. Government provide leadership in government-to-government interfaces. In particular, this has become readily apparent during the past several years in connection with the prodigious efforts by the European Community to adopt a system of common standards. It is essential that U.S. interests work with the European Community in order to establish and assure a workable means for U.S. manufacturers to meet EC standards and continue to have access to European markets. However, a private sector organization cannot play the role of international negotiator for U.S. interests. Instead, government-to-government negotiation to develop and implement acceptable agreements is necessary for the continuation and even possible expansion of the free trade between the U.S. and other nations. Nor is this heightened attention to international standardization limited to the European Community; although perhaps spurred by them, standardization is receiving increased attention by Asian and Third World nations as well. Unless the U.S. Government takes an activist role in representing and supporting U.S. interests in these activities, U.S. competitiveness could be severely jeopardized.

In what should be reviewed as a possible model for other similar endeavors, ASME within the past year has formed a Pressure Technology Sectoral Advisory Committee ("PT-STAC") to assist the U.S. Government in the development of positions for use as a basis for negotiations with the European Community, and other regional technical and trade entities, on matters relating to pressure equipment. This PT-STAC was formed as a result of a recommendation from industry at a joint ASME/NIST Conformity Assessment Workshop on Pressure Vessels, held on January 31, 1991. It seemingly points the way toward a productive partnership of standards development and accreditation organizations, government and industry in coordinating standards and accreditation activities.

Initially, PT-STAC was formed as a committee under ASME's Board on Pressure Technology Codes and Standards with representatives from affected ASME technical bodies, the U.S. Government and organizational representatives. To date, the membership includes representatives from the National Institute of Science and Technology ("NIST") (Vice-

Chairman of PT-STAC), U.S. Department of Commerce Office of European Community Affairs, Pressure Vessel Manufacturers Association, American Boiler Manufacturers Association, ASME Board on Accreditation and Certification, ASME Boiler and Pressure Vessel Committee, American Insurance Association, National Board of Boiler and Pressure Vessel Inspectors, and ASME Pressure Piping Committee, and have invited the American Petroleum Institute, ASME Standardization of Valves, Flanges, Fittings and Gaskets Committee, and Materials Properties Database Network to provide representatives.

Through its first three meetings, PT-STAC has provided a highly productive forum for establishing an understanding of evolving European Community standardization requirements and providing feedback from U.S. organizations which would be affected regarding concerns which need to be represented and negotiated on behalf of U.S. interests in order to allow for continued free trade after the European Community standards requirements go into effect.

The Council on Codes and Standards believes that participation in such sectoral technical forums is a desirable role for the U.S. Government. Such a partnership between government, private sector standards development and accreditation organizations and industry in coordinating and implementing a National Standards Policy is clearly preferable to the Office of Technology Assessment's proposed alternatives of having either the Interagency Standards Policy Committee or NIST undertake this role acting alone.

C. A New Institute Should Be Formed As A Public Corporation to Oversee and Implement National Standard Policy

The ASME's CCS has for several years advocated the establishment of an independent national Institute for Standards and Conformity Assessment to oversee and implement national standards, accreditation and certification activities. ASME's recent experiences with PT-STAC have served to reinforce its earlier observations about the desirability of moving in this direction. Accordingly, the Council on Codes and Standards enthusiastically supports the Office of Technology Assessment's recommendation for the creation of such a new public corporation.

This Institute should be organized as a "partnership" to include all of those entities which are directly affected by standards and accreditation activities. For example, a suggested Board of

Directors of such an Institute should include about one-third each from government (federal and state); industry (manufacturers and users); and standards development and conformity assessment organizations. There also could be representatives from the general public.

This Institute would provide the necessary forum for developing national policies and strategies on standards, accreditation and certification issues, including establishing positions for representing U.S. interests in international negotiations with other governments. Such an Institute may be the difference between a piecemeal and disorganized private sector approach to international standards and a healthy worldwide system for standards and conformity assessment programs.

Such an Institute also would fill the clear and pressing need for at least quasi-governmental oversight and an objective level for "due process" appeals that both go beyond the current private sector requirements and is supportable in the courts. We strongly believe that such an alternative source is required to assure a lack of the bias and abuse of competitive opportunity which plagues the current strictly private sector system. Unless this situation is improved, U.S. interests in international commerce could be severely harmed.

In addition, this Institute should develop, through consensus, criteria for standards development and conformity assessment organizations and audit accredited organizations to assure compliance.

At a June 21, 1991 meeting between U.S. and European Community delegations, then Secretary of Commerce Mosbacher agreed that the U.S. Government will provide assurance on conformity assessment when requested. As a private sector organization that has administered conformity assessment programs since 1915, CCS supports the concept of an independent Institute, to work on behalf of the U.S. Government in implementing Secretary Mosbacher's pledge, as well as generally, to provide the oversight assurance for conformity assessment and for related standards developing organizations within the U.S. This Institute could be limited in scope to those conformity assessment programs that are referenced by government (federal and state) as a means of satisfying internal regulatory requirements or international trade criteria. In addition, it could be required that any standards developer or conformity assessment sponsor that wants to be referenced in federal procurement contracts or regulations be accredited by this Institute.

ASME already has had a positive experience with quasi-governmental "internal audits" of its accreditation programs, which can serve as a model for this projected role of the Institute. During the restructuring of ASME in 1980, a Board on Accreditation was created, with one of its duties being to provide for "internal audits." To implement this new requirement, that Board recommended that the Council on Codes and Standards request the federal agencies that reference ASME accreditation as a means of satisfying a regulatory requirement to provide quality assurance specialists to participate in the "internal audits" of ASME's accreditation programs. As a result, four agencies of the U.S. Government provide quality assurance specialists for audit teams. The "findings" of deviations from ASME's procedures and "observations" for improvements by the team are reported to ASME and are considered to be valuable, constructive input to our programs.

Lastly, we must emphasize in closing that the proposed Institute is not an invitation for a government takeover of the private sector voluntary standards process in the United States, as some have and will allege. Rather, it is a call for a partnership between industry, government and private standards development and conformity assessment organizations. It is a concrete recommendation which recognizes the national government's necessary and proper role in meeting the pressing needs of rapidly proliferating international standardization, as well as in assisting correction of the existing domestic systemic flaws. It is the Council on Codes and Standards' sincere hope that the recently heightened national awareness of the need for strategies to enhance U.S. economic competitiveness will lead to a national consensus for the creation of this Institute for Standards and Conformity Assessment.

Mr. Chairman, that concludes my Statement. Thank you for the opportunity to express the views of the ASME's Council on Codes and Standards on these important issues. I would be happy to respond to any questions.

AAES AMERICAN ASSOCIATION OF ENGINEERING SOCIETIES

Statement

of the

Engineers' Public Policy Council of the
American Association of Engineering Societies

before the

House Science Subcommittee on Technology
U.S. House of Representatives

on the

FY 1996 Authorization of the
National Institute of Standards and Technology

April 3, 1995

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The Engineers' Public Policy Council of AAES is pleased to submit our views on the FY 1996 authorization for the National Institute of Standards and Technology. AAES is a multidisciplinary organization dedicated to coordinating the collective efforts of over 800,000 members to advance the knowledge, understanding, and practice of engineering.

It should be noted that NIST's budget is the only portion of the federal budget devoted to the specific purposes of enhancing and leveraging industry's development and use of technology. Is should also be recognized that NIST helps small and medium-sized companies as much as it helps large companies, and that it is not engaged in picking corporate "winners and losers." NIST provides support for all industries based on technically sound, merit-based proposals free of political influence.

NIST's mission is to help U.S. industry maintain its clear, though slipping, international lead in those technologies deemed critical to our nation's competitiveness. It does so by conducting a world-class program of scientific and engineering standards and measurements, which are tools essential for all businesses that design and produce technology-based goods and services. It also does so by working in partnership with industry to develop generic and enabling technologies and quality-based manufacturing processes in high risk areas that industry is not able to fund on it's own. These new technologies and advanced manufacturing processes, in turn, can be adapted and commercialized in the private sector as new products and services, which open new markets, produce economic opportunity, and generate high value added jobs.

We share the common concern that deficit spending must be reduced and we are fully aware of the budget constraints with which Congress must contend. Interest on the debt is sapping away the capital resources available for productive investment in our society. At the same time, however, we believe that the Federal government can and must continue to play an effective role in helping industry bridge the gap between federally-supported basic research and commercialization of technology by industry. Such an investment furthers our economic growth and standard of living in an increasingly competitive global market.

Standards and Measurements Laboratory Programs

We support the administration's efforts to strengthen NIST's laboratory programs and believe that these programs should be given priority in the NIST budget. NIST's standards and measurements mission is the cornerstone of its efforts to support the competitive health of U.S. companies. Since its days as the National Bureau of Standards, NIST has provided practical tools such as methodologies and standards for making measurements, evaluated data, and testing methods used by companies, both large and small, across all sectors. The necessity of providing such services has been well-recognized as long as we have been a nation, as reflected by the U.S. Constitution, which empowers the federal government to set the standards of weights and measures.

Much of NIST's standards and measurements effort represents an investment in what might be called "infrastructural" technologies, or generic technologies needed by industry for use in commercializing other technologies as products and services. It is in this area where industry historically fails to adequately invest. This is because the measurement technology will be widely shared by companies as they develop competing products and since the measurement technology is not itself typically incorporated into a product or service whereby the related R&D costs could be recovered.

Despite the overall constraints on budgeting, we believe that a strong case can be made for increases in NIST's laboratory budget. In addition to meeting the growing technical needs of established industries, NIST must also be able to support industry's standards and measurements needs in new and emerging technology areas. In a global market where the life-span of a new, competitive technology is often measured in months, rather than years, U.S. industry often depends on prompt action by NIST to provide the necessary standards and measurement tools necessary for commercialization.

While industry does not need NIST to set standards, NIST plays an important role as a monitor, conveyer, facilitator, and producer of background material for standards development led by the private sector. In the area of conformity assessment, we support efforts by NIST to serve as a focal point for information relevant to the General Agreement on Tariffs and Trade (GATT). We do, however, believe that other conformity assessment activities of NIST - such as the National Voluntary Conformity Assessment Systems Evaluation (NVCASE) and the National Voluntary Laboratory Assessment Program (NVLAP) - should be self-supporting.

Congress should also be aware that recent and proposed cuts to R&D programs of other Federal departments and agencies can have a significant impact on NIST's laboratory programs. These cuts will ultimately affect non-appropriated revenue derived by NIST from fees, in-kind contributions, and contract research done for the Department of Defense, the Department of Energy, and other Federal agencies. They threaten to disrupt NIST's core laboratory programs. Accordingly, Congress should maintain a strong funding for NIST's laboratory program.

Advanced Technology Program

Unlike the government-directed "industrial policies" of our principal national competitors, NIST's Advanced Technology Program (ATP) embodies a uniquely American approach to strengthening our competitive posture, with industry leading the way in determining areas for commercially relevant innovations and working in partnerships with government support on the generic and enabling technologies needed to realize these new products and services.

The relatively small sums represented by an ATP grant can make all the difference for a small or medium-sized company with an innovative concept but which is unable to find private sector sources willing to invest in the higher risk initial R&D stages. While the venture capital market is growing, such funds generally look for less risk and a quicker return on investment than projects supported by ATP can provide. Without ATP, these companies generally have three options: 1) abandon a promising technology, 2) sell the rights to their innovation to foreign competitors, who will enjoy the lion's-share of profits and jobs that result from successful commercialization, or 3) struggle along in the hopes that investors will eventually be found, while meanwhile, foreign competitors move rapidly to commercialize their technologies and use their first to market advantage to lock up market share. None of these options are productive for the U.S. economy. While endorsing the legitimacy of the ATP approach, we also believe there are clear boundaries to the government's role:

- Industry leadership and matching funds are essential; ATP should not (and does not) support high-risk technology efforts unless private companies are willing to make a significant financial commitment to the project. On average, companies have provided more than 50% of the costs of the research.

- ATP must continue to provide balanced support for companies both large and small and emphasize collaborations such as consortia of small companies and joint ventures that help leverage the available funding and broaden the dissemination of research results.

- ATP should not compete with the private sector as a resource for capital funding. To avoid this, ATP must continue to focus on high-risk, potentially high pay-off efforts for which capital investment in our economy is not currently available.

- ATP funding must continue to be awarded competitively, with proposals selected for funding on the basis of their technical and business merit by individuals qualified to do so.

- ATP awards should not support consortia to develop standards outside the private sector voluntary consensus system.

- Commercialization must continue to be left to the private sector.

As a relatively new program, ATP's track record is encouraging but admittedly incomplete. Technologies are not commercialized overnight and it takes time to realize return on investments. Thus, Congress should continue to scrutinize ATP to ensure that it stays within these boundaries and that tax-payer dollars are productively spent. As the program proves itself and until the high-risk capital market changes for the better, funding should continue to be increased to a level sufficient to ensure national impact. Unless adequately funded, the broad economic benefits of the program cannot be fairly evaluated.

We believe the argument that government bureaucrats should not be trusted over the private market to target promising new technologies ignores two key points: First, the private market produces the ATP research ideas, develops the business plans, and judges the merit of projects. Second and more important, ATP helps companies fund those high-risk technologies that would not likely be funded otherwise because companies cannot afford to bear the cost alone for reasons cited above. Thus, ATP supported research is not designed to compete with or substitute for projects funded entirely with private funds, but to fill a void critical to our economic growth. The argument that projects not funded entirely with private funds are not worth funding at all overlooks many examples of productive government/industry partnerships.

Manufacturing Extension Partnership Program

Noting by analogy the success that agricultural extension services played in helping to make American agriculture one of the most competitive industries in the world, we support government outreach and extension services to industry, embodied in NIST's Manufacturing Extension Partnership (MEP).

Manufacturing extension is particularly valuable to small and medium-sized U.S. manufacturers, the primary job producers in our economy, by affording them the opportunity to assimilate proven technologies and by providing guidance on technical issues that these cannot solve on their own. Even small improvements to enhancing the productivity of a manufacturing line and/or reducing the cost of production can make a big difference for these companies in ensuring that they stay in business. The ability to make these improvements is becoming even more critical as small and medium-sized companies are increasingly exposed to foreign competitors in the U.S. market and the necessity of competing in the global market to remain viable.

For these reasons, we encourage Congress to maintain its support for NIST's Manufacturing Extension Partnerships, including a sufficient number of centers and development of an information network that ensures access by small and medium-sized businesses in all states and regions. We support the administration's recommended growth in this important program, and it should be recognized that the budget request also serves to integrate existing manufacturing extension centers funded by the Department of Defense, thereby freeing defense funds to help ensure our military readiness and other purposes.

Construction and Major Renovation of Facilities

The need to renovate and upgrade NIST facilities to provide reliable power, adequate environmental controls, and state-of-the-art capabilities remains critical to the Institute's ability to successfully meet its technology mission. We urge Congress to provide adequate funding for facilities renovation and construction.

Conclusion

The engineering profession believes NIST programs have an important role to play in sustaining the competitiveness of U.S. industry, both large and small. NIST's standards and measurements program, industry-lead precommercial R&D, and manufacturing extension efforts are not about picking "winners and losers" in the marketplace. Rather, they ensure that all companies, both large and small, have the basic tools they need to be competitive in the global marketplace. We urge the Subcommittee to provide strong support for NIST programs and to resist the temptation to cut investments essential to our nation's long-term economic health.

AAES American Association of Engineering Societies

1995

AAES Member Societies

American Academy of Environmental Engineers
American Indian Science & Engineering Society
American Institute of Chemical Engineers
American Institute of Mining, Metallurgical and Petroleum Engineers
American Institute of Plant Engineers
American Nuclear Society
American Society for Engineering Education
American Society of Agricultural Engineers
American Society of Civil Engineers
American Society of Mechanical Engineers
Institute of Electrical & Electronics Engineers
National Institute of Ceramic Engineers
National Society of Professional Engineers
Optical Society of America
Society of Fire Protection Engineers
Society of Hispanic Professional Engineers
Society of Women Engineers

Advisor/Observer

National Academy of Engineering

AAES Associate Societies

Association for International Practical Training
Federation of Materials Societies
INFORMS
National Action Council for Minorities in Engineering
NACE International
National Council of Examiners for Engineering and Surveying
Tau Beta Pi Association
The American Society for Nondestructive Testing, Inc.

AAES Regional Societies

District of Columbia Council of Engineering & Architectural Societies
Engineering Society of Detroit
Washington Society of Engineers

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(202) 296-2237 • (202) 296-[illegible]151 (FAX)

APPENDIX III

American Enterprise Institute for Public Policy Research

AEI

March 29, 1995

MEMORANDUM

TO: Shanon Pugh
FROM: Cynthia Beltz

RE: Testimony for March 23, 1995

Shannon,

Please find attached the requested diskette in WP 5.1. Also attached is a venture capital article that I want added to the record. If you have any additional questions, please give me a call at 202/862-7197.

With kind regards,

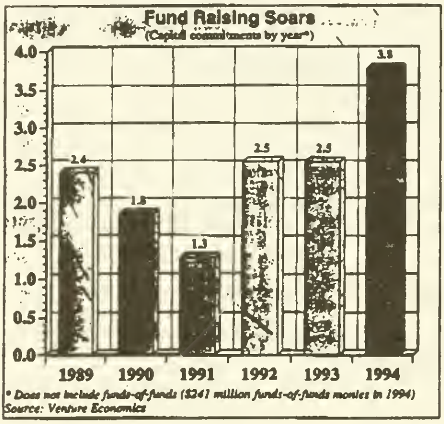
Cynthia Beltz

1150 Seventeenth Street, N.W., Washington, D.C. 20036 202/862 5800 Fax 202/862 7177

Fund Raising Renaissance

Venture capital commitments swelled 48% to $3.764 billion in 1994, leading many to ask if history is doomed to repeat itself.

By Lisa Vincenti, senior writer



Fund Raising Soars

(Capital commitments by year*)

** Does not include funds-of-funds ($241 million funds-of-funds monies in 1994)*

Source: Venture Economics

Venture capital fund raising in 1994 soared to near-record levels, eclipsed only by 1987 when partnerships netted a cool $4.184 billion.

Last year, fund-raising levels ballooned to $3.764 billion (excluding funds-of-funds), jumping by $1.2 billion from 1993's $2.545 billion, according to figures provided by *Venture Economics*. Eighty groups held closings in 1994, an increase of 74% over the previous year when 46 firms secured commitments.

Return Of The Lemmings?

Many more first-time funds raised money last year. Partnerships with specialized stage or industry focuses also gained popularity.

Naturally, the flood of capital commitments has some participants wary that last year's swell will lead to a 1980s redux (too much money chasing too few deals) and to the re-emergence of the lemming principal, which governed deal making during that giddy season in the industry's history.

Others in the industry are more sanguine, soothed by the fact that, as opposed to the 1980s, most of the money is flowing into the hands of experienced investors. Most of the venture capitalists funded have seen a down cycle; the question is will they remember the lessons learned.

In addition, the venture capitalists funded in 1994 realize the importance of sticking to a fund's stated investment strategy, notes one adviser. Furthermore, $4 billion in 1987 isn't the same as $4 billion in 1994, says Guy de Chazel, a general partner at Morgan Stanley Venture Capital.

Also, if this year's fund raisers are as creative and proactive as they advertise in their marketing materials, they will uncover better deals and not fall prey to the lemming factor.

"Business did very nicely with the low $1.27 billion and worked well in the $2.5 billion range," says one money manager. "This year at $3.8 billion, competition is increasing, people are buying deals," he says. But he adds, "It's not crazy. It's not a meltdown."

Several factors fueled the torrid fund-raising climate, including:

- Low return expectations for other asset classes;
- The return of many brand-name firms to the market (More than 55 groups re-entered the market with follow-on funds.); and
- Spin-offs of new groups from established firms.

Limited and general partners surveyed expect fund raising to slow down next year because fewer follow-on funds are expected to hit the market. Summit, Weston Presidio, Sevin Rosen, Sierra, Mayfield and Sequoia are among those expected to return.

Trend Reversal

Despite the surge of money into the industry, the average size of partnerships raised in 1994 fell to roughly $50 million from just more than $59 million in 1993. That compares with an average fund size of $62 million and $42 million in 1992 and 1991, respectively.

This marks a reversal, at least for now, of the long-term trend toward funding fewer but larger venture capital partnerships. In part, this phenomenon is due to the strong showing by early-stage partnerships, which are typically smaller than later-stage and balanced funds.

Thirty seed/early-stage funds amassed a total of $1.226 billion in 1994, nearly double the amounts secured in 1993 and 1992 when seed and early-stage funds collected $602 million and $662 million, respectively.

Several brand-name funds secured sizable pools for early-stage investments. Together, partnerships of Kleiner Perkins Caufield & Byers ($250 million), Institutional Venture Partners ($140 million) and Domain Associates ($125 million) accounted for nearly half of all the seed/early-stage capital raised in 1994.

Eight funds with targets larger than $150 million collected a total $1.078 billion in 1994. These include: Advent Global Private Equity II, $315 million; APA Excelsior IV, $199 million; Frontenac VI, $218 million; Greylock Equity, $175 million; InterWest V, $195 million; Kleiner Perkins Caufield & Byers VII, $225 million; New Enterprise Associates VI, $230 million; and Oak VI, $225 million.

Follow-On Funds

Fund Name	Amount Raised 1994	Total Raised
Advent Global Private Equity II+	$155 mil.	$315 mil.
AM Fund	15	15
APA Excelsior IV*	199	199
Arch Venture Fund II	29	29
Austin Ventures IV+	115	115
AVI III*	25	25
Bachow Investment Partners III*	72	72
Battery Ventures III+	85	85
Boston Capital Ventures III*	50	50
Charles River VII	85	85
CID Ohio Equity Capital Fund+	20	20
Coral Partners IV*	79	79
Dillon Read Venture Partners III*	50	50
Domain Associates III+	125	125
Edelson Technology Partners III*	31	31
Edison Venture Fund III*	47	47
Euclid Partners IV*	20	20
Food Fund II	6	6
Frontenac VI+	43	218
Greylock Equity+	175	175
Grotech Partners IV+	75	126
Institutional Venture Partners VI+	140	140
Intersouth III*	20	20
InterWest V+	20	195
Kitty Hawk Capital III*	28	28
KPC&B Founders Fund	25	25
Kleiner Perkins Caufield & Byers VII+	225	225
Laboratory Partners (Ampersand)	20	20
Medical Innovation Fund II+	6	22
Medical Science Partners II*	15	15
Mesirow Capital Partners VI+	17	66
Morgan Stanley Venture Capital II	46	126
Nazem & Co. IV	56	56
New Enterprise Associates VI+	36	230
Noro-Moseley Partners III	48	48
Oak VI+	225	225
Olympic Venture Partners III*	35	35
Omega Venture Partners II	43	43
One Liberty Fund (Morgan Holland)*	50	50
Onset Enterprise Associates II+	51	51
Phillips-Smith Specialty Retail III+	33	70
Primus Capital Fund III	74	74
RFE V*#	36	36
Royalty Capital Fund I+	3	3
Sigma Partners III+	60	60
South Atlantic Venture Fund III	40	40
Southern Venture Fund II*	25	25
SSM Venture Partners+	43	43
Technologies for Info. and Entertainment*	30	30
Technology Leaders II*	61	61
Technology Partners V+	57	57
Threshold III (T.Rowe Price)*	55	55
Tritech (Triad Investors)	11	11
U.S. Venture Partners IV+	75	135
Woodlands/Essex Fund III*	38	38
Zero Stage Capital V#*	11	11
Subtotal†	**$3,259 mil.**	**$4,220 mil.**

** still raising capital* *# SBIC* *+ oversubscribed*

† affected by rounding *Source: Venture Economics*

First-Time Funds

Fund Name	Amount Raised 1994	Total Raised
Adobe Ventures	$25 mil.	$25 mil.
Anthem	13	13
Byrd Business Investments#+	5	5
Chartwell Capital Investors*	25	25
Cross Atlantic Partners+	25	25
FCP Southeast Investors+	53	53
Heartland Capital Appreciation Fund+	53	53
Heartland Capital Fund*	8	8
Individuals Venture Fund	5	5
Information Investment Partners	15	15
Interactive Media (Unterberg Harris)	20	20
Kansas City Equity Partners I#*	3	8
LM Capital Associates II*	35	35
MidMark Equity Partners#*	17	17
North Bridge Venture Partners I+	60	60
Novus Ventures*#	5	5
Richland Ventures*	48	48
River Cities Capital Fund#	12	12
Rosewood Capital+	80	80
Schroder International Life Science Fund	55	100
Spectrum Equity Investors+	109	109
Three Arch Partners+	28	28
Vector Later Stage Equity Fund*	39	39
Vertical Medical Associates†	14	14
Subtotal†	$747 mil.	$747 mil.
Total†	$4,006 mil.	$4,967 mil.

** still raising capital* *# SBIC* *+ oversubscribed*
† affected by rounding

Source: Venture Economics

Although industry pundits have been lamenting the lack of funding flowing to first-time funds, which bring fresh blood and new ideas to the market, some are now raising concerned eyebrows at the large number of first-time funds in business.

Thomas Judge, head of AT&T's pension program, is one of those concerned. He recalls the early 1980s, when a number of novices raised money and "fell flat on their faces."

Mr. Judge is somewhat soothed by the fact that a number of the new funds raised last year are being managed by seasoned venture capitalists working together for the first time. With these groups experience isn't an issue; the key risk is the chemistry between general partners who have not worked together previously.

Anthem, Cross Atlantic Partners, North Bridge Venture Partners, Novus Ventures, Richland Ventures, Rosewood Capital, Spectrum Equity Investors and Three Arch Partners are among the new funds made up of mature professionals that raised money last year.

In all, spin-offs or other configurations of new teams of practiced venture

These $150 million-plus funds accounted for 27% of the capital raised in 1994 (including funds-of-funds), as compared to five firms collecting a total of $953 million, or 35.1%, of all the capital raised in 1993 and seven partnerships garnering $1.331 million, or 50.8%, of total commitments in 1992.

Capital Commitments by State

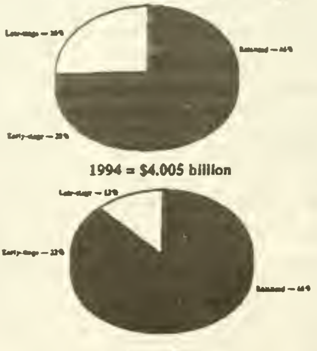
State of Office	Number of Funds	Amount Raised
California	15	$863 mil.
Connecticut	2	261
Florida	3	118
Illinois	4	127
Massachusetts	16	923
Maryland	5	190
Minnesota	3	91
North Carolina	2	48
New Jersey	4	220
New York	9	465
Ohio	3	106
Pennsylvania	2	133
Tennessee	4	121
Texas	4	200
Other	4	139
Total	80	$4,005 mil.

First Timers

The most startling development in 1994 was that 24 of the 80 venture funds that held a close in 1994 were so-called first-time funds. These groups managed to collect $748 million, more than double the $304 million raised by new groups in 1993. In 1992, new firms raised a meager $172 million.

Early-Stage Funds Advance

(1994, 1993 capital commitments by stage)



Source: Venture Economics

UNITED STATES DEPARTMENT OF COMMERCE
National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161
OFFICE OF THE DIRECTOR

March 30, 1995

The Honorable Constance A. Morella
Chairwoman, Subcommittee on Technology
Committee on Science
House of Representatives
Washington, D.C. 20515

Dear Madam Chairwoman:

Although last week's hearing on the Technology Administration's budget request for Fiscal Year 1996 did not deal specifically with matters pertaining to the National Technical Information Service (NTIS), I want to thank you for your long-standing support for our programs. I would like to take this opportunity to clear up some issues involving the Service that were raised in a statement submitted for the record by Mr. Daniel C. Duncan on behalf of the Information Industry Association.

Mr. Duncan's main points are that we are (1) charging user fees in excess of the cost of dissemination in violation of Administration policy as set forth in OMB Circular A-130, (2) engaging in certain practices that have the effect of reducing public access to public information, and (3) gaining inappropriate control over whole classes of information as a result of services we provide to agencies to help them meet their obligations under the American Technology Preeminence Act (ATPA) and the Freedom of Information Act (FOIA).

With respect to the first of these, NTIS is implementing the Administration's instruction that agencies refrain from charging user fees in excess of the cost of dissemination in a manner that is also consistent with our legislative mandate to be self-sustaining. OMB's requirement is generally directed at agencies that receive appropriations for producing public information and precludes them from charging the public a second time for the same costs. The Service complies with the principle and remains self-sustaining by applying the directive on average rather than to each transaction.

With respect to the second point, I would note simply that NTIS' ability to operate on a self-sustaining basis depends on maximizing public access, providing information in whatever format makes the most sense to our customers, and providing information-related services to the Federal agencies who are our suppliers. Our ability to respond to the way our suppliers produce and customers use information requires us to be agile and flexible. As a result, NTIS has been able to meet its operational needs and plan for its modernization while also performing a number of important public services that must be paid for but that are unlikely to yield significant revenue. Examples of the latter range from preserving a vast storehouse of historically important scientific and technical information to providing 1400 depository libraries with free online access to a complete listing of NTIS' newest documents.

Our success depends on enhancing - not reducing - public access. NTIS enters into a number of arrangements to achieve its goals. Some arrangements are joint ventures; some are not. Some are exclusive; some are not. We enter into exclusive joint venture arrangements only when they are in the public interest, as when they can be used to induce a partner to provide important value-added services that would not otherwise be available and which make it easier for the public to learn about and acquire Federal information. Most importantly, our joint venture guidelines make it clear that we never grant exclusive rights in the U.S. to any of the underlying information generated by the Government.

With respect to the last point, I assure you that we are in no danger of becoming an information monopoly. Federal agencies, especially those having their own dissemination systems, are interpreting their obligations to provide us with copies of their scientific and technical information products narrowly. Agencies that lack sufficient funds to provide free copies of their products, or to print more copies, will refer callers to NTIS, but that is hardly the same as ceding control to us. Similarly, our FOIA service is an efficient way for agencies to avoid the high cost of searching for requested information that is in the form of publicly available technical information products. NTIS has absolutely no control over the internal files of Federal agencies.

As information purveyors, we strive to maintain good relations with the information industry. I am always available to meet with members of the information industry and to visit you or your staff to discuss any aspect of our operations.

Sincerely,

Don Johnson

Donald R. Johnson
Director

Survey of ATP Pilot Program Awardees: Interim Report

Prepared by:
Silber & Associates
13067 Twelve Hills Road
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Phone & Fax (410) 531-2121
March 13, 1995

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The Survey of ATP Pilot Program Awardees: Interim Report

Background

As part of its program evaluation plan, the Advanced Technology Program is in the process of studying the impact of the award on companies who received ATP funds during the four years following the program's inception. The ATP Office contracted Dr. Bohne Silber of Silber & Associates, an opinion research firm in Maryland, to carry out this study through an extensive telephone survey of ATP awardees.

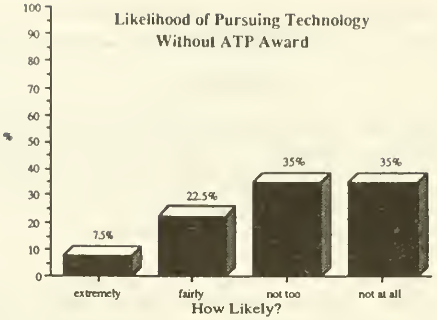
The survey began recently (in January, 1995) and to date, 40 interviews with recipients of 1991 ATP awards have been completed. Ultimately, approximately 180 companies, recipients of ATP awards from 1990 to 1993, will be interviewed to evaluate the impact of the ATP program. The final report is scheduled for delivery by early 1996. The sample of 40 companies covered by this interim report consists of eleven single applicants, five joint venture lead organizations, and 24 joint venture participating companies. These were the first recipients with whom we were able to schedule interviews; there is no other basis for their selection. They represent a little more than half the 1991 group.

The survey questionnaire, which focuses primarily on the impact of the award on companies' technological advances, progress toward commercialization, collaborative relationships, and other critical factors, consists of nearly 150 open- and closed-ended questions, requiring about 90 minutes to administer to each interviewee. This interim report contains results for only a few of the questions which are included in the study, and only for the 40 companies. We have selected for inclusion results that address key facets of the interviews, namely, likelihood of pursuing the technology without ATP, acceleration, collaboration, commercialization progress, and critical benefits to date. The results included provide specific examples of how quantitative and qualitative results are presented.

Early Impacts on Recipients

Likelihood of Pursuing Technology Without ATP Funding

Twenty-eight (70%) of the 40 respondents reported that their organization would have been unlikely to pursue the ATP-funded technology without the enabling boost of the ATP award (see figure on following page). [To be specific, 14 of the 28 described the probability as "not too likely" and 14 said "not likely at all."] A few, in fact, said that without the award, they would have been forced to close their doors.

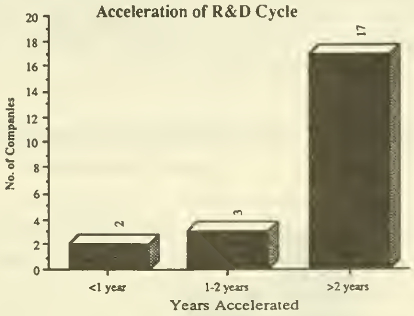


Most respondents explained that because of the high-risk nature of the technology, their company could not bear the risk without government support. Some spoke of an uneven international playing field: "We're now the market leader in our area and have forced [a Japanese company] to abandon U.S. marketing efforts. ATP was a significant piece of that." Others spoke of resource barriers: "At the time of our reward, we didn't have the capacity in terms of personnel or research tools. Now we're the leading facility in the world for researching this technology, and the majority of this change is due to ATP. ATP has gotten us over technical hurdles, and we can now get funding for applications. ATP was a very critical step in our path."

Of the twelve companies (30%) in the sample who speculated that they would have forged ahead, even without ATP funds, all of them said their level of effort and goals would have been very different without ATP support. The ATP funds, according to these twelve companies, enabled them to take great strides where they would have been creeping. As stated by one respondent, "We would have been doing incremental research, not this enabling research which requires critical mass." Other companies added comments such as, "We would not be able to follow this high-risk path as long or as intensely;" and "ATP was critical for us. Time to market is critical and we would have been delayed without it. We never could have recovered that time."

Effect on R&D Cycle Time

All but one of the 40 companies reported that the ATP award accelerated their R&D cycle for technology development, thereby expediting progress towards commercialization. As the figure on the following page shows, most awardees believe they are two years or more ahead of schedule because of the award, and some companies placed the benefit at 5 - 10 years. (The companies who are not represented in this graph are those who declined to estimate the time savings, saying they would have been unable to develop the technology at all without the ATP award.)



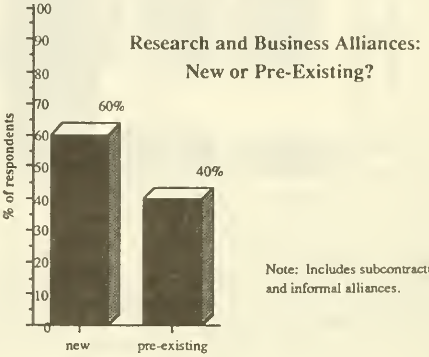
Stimulation of Collaboration

The respondents were enthusiastic about discussing the alliances they have formed. According to a number of companies, collaboration between suppliers and end-users makes perfect sense but rarely happens without the impetus of a program like ATP. "ATP is a rallying point," said one of the respondents. "If not for the ATP, there wouldn't be this collaboration. It's what got us all together, and the effect is pervasive...We wouldn't have done this without the plum of government funding, the leverage. The working together is key." "A key part is the interface with our users, our customers," according to a respondent.

The companies appear to see collaboration as the future for American businesses, despite a historical tradition of independence: "It's not in the American psyche to work with competitors cooperatively," offered one survey participant, "but now we see a huge acceleration of collaborative projects and programs. We've learned how to work in the joint-venture environment." Another company commented, "We wouldn't have connected with [our collaborative partner], and that relationship has been a major impetus."

The ATP awards have spurred creation of new alliances, ones formed solely because of the ATP-funded project (see figure on following page). The 40 companies represent eight different joint venture projects. Two of the joint ventures (each of them comprised of two companies only) reportedly existed prior to the ATP award; the others did not.

Collaborations abound among the single-company awardees, as well as in the joint ventures. Taking into account subcontractual arrangements and informal alliances of the single-company awardees and formal joint-venture partnerships, 60% of the individual respondents who were questioned said they are collaborating with companies with whom they've never done business before. Many of them are collaborating with two or more new partners, and one company said the ATP project has led them to form 12 business alliances which did not exist previously.



Note: Includes subcontractual arrangements and informal alliances.

Progress Towards Commercialization

Twenty-three of the 40 companies are the focus of this section because they are the ones with primary responsibility for commercializing a product or process resulting from their ATP project. Eighteen of the 23 (78%) report they've already taken some steps toward commercialization. These respondents were asked whether their company has reached various benchmarks in the road to market, and their responses are shown in the table below. (Percentages are based on the responses of the 23 companies who intend to commercialize a product or process.)

OF THOSE COMPANIES INTENDING TO COMMERCIALIZE (n=23):

Has your company...	% affirming
held licensing negotiations?	30.4%
held negotiations with potential alliance partners?	56.5%
completed product or process definition?	60.9%
completed concept testing with customers?	60.9%
completed product or process development?	39.1%
developed a lab prototype?	65.2%
developed a production prototype?	39.1%
set up a pilot production or commercial demo?	43.5%
determined production rates?	26.1%
conducted a sales and revenue forecast?	47.8%

Summary of Program Benefits

At the end of the interview, following lengthy discussion of the impact of the ATP award, respondents were asked to choose from a list of potential impacts the three which they consider most significant to their company. (Respondents were encouraged to add to the list of potentials from which they would make the choices.) The table below shows their responses in order of importance.

Critical Benefits of the ATP Award

1. Enabled company to afford and engage in high-risk research

2. Accelerated commercialization of ATP-related technology

3. Stimulated collaboration and formation of strategic alliances

General Comments

Survey participants made numerous comments staunchly supportive of the ATP. Only a few negative statements were made, pertaining mostly to the difficulties of contributing matching funds (for example, "The matching requirement is very burdensome when the significant returns are beyond five years...The typical investment cycle is three years to market.").

Since most comments were positive, a sampling of those follow. Concerned that their comments would be dismissed as biased, some respondents emphasized that their funding is over, and that they have no reason to "whitewash" the program.

- "The ATP program is one of the best investments of taxpayer dollars I've known. I've seen one-fourth the results for twice the money with other federal programs."

- "If a goal of ATP was to help small American companies be successful, it has achieved that goal. The program helped keep the market [we're involved in] in American hands and gave us a dominant market position."

- "It would be national suicide to discontinue the ATP program. U.S. companies cannot withstand the way foreign governments fund our foreign competition."

Manufacturing Extension Matters

Building the National
Manufacturing Extension Partnership

Jack Russell, President

The Modernization Forum

Manufacturing Extension Matters:

Building the National Manufacturing Extension Partnership

Manufacturing matters to America. Making what the world wants makes us a prosperous nation. And smaller manufacturers matter particularly. America's 381,000 manufacturing establishments of less than 500 workers employ nearly 12 million people and account for over half of our manufacturing production. Small and midsized firms make most of the parts, components, and tooling required by large manufacturers. They form the broad supplier base of our great metropolitan manufacturing centers and anchor jobs in smaller cities and towns across America.

Today, America's smaller manufacturers are challenged as never before. To perform in the emerging global marketplace, they must master modern technologies, management techniques, and methods of work organization. Our economy will be stronger if thousands of small and midsized firms accelerate modernization of their design, production, and marketing capabilities and the management methods that focus them.

The leaders of small and midsized manufacturers must drive modernization of America's industrial base. As they commit their companies to continuous modernization they would benefit from the support of resourceful organizations dedicated to their success. Unfortunately, most private for-profit consulting organizations have not been able to earn a competitive return serving small- and midsized manufacturers because of the high cost of sales required to reach many firms with modest resources.

Now, a growing number of smaller manufacturers can draw assistance from the Manufacturing Extension Partnership (MEP), the nationwide network of regional and local centers organized by the National Institute of Standards and Technology (NIST) and its state and private sector partners. Begun under President Reagan, enhanced under President Bush, and expanded under President Clinton, the NIST MEP has received growing support from Congress since 1989. $90 million is appropriated for the NIST MEP in FY95. Today, 44 MEP centers and eight related pilot programs have been established in 40 states.

This federal investment is already earning a good return and developing markets. It leverages large matching investments by states. Most importantly, manufacturing firms that use MEP centers now report hard benefits of almost $7 for every federal dollar the centers receive. Centers often use private consultants in their projects with firms and the firms assisted by MEP centers are *more* inclined to use private consultants in the future.

Like the firms they serve, the partners in the NIST MEP strive for continuous improvement. MEP centers listen to their customers and to their state and federal investors. In the spirit of continuous improvement, they welcome hard questions from the 104th Congress and offer the following responses to eleven questions that have already been posed.

Some Questions & Responses on Manufacturing Extension

1. Why Are Small- and Medium-Sized Manufacturers Particularly Important? Small- and medium-sized manufacturing enterprises are the foundation of American industry and do more and more of America's manufacturing.

Small- and medium-sized manufacturers are the broad supplier base for U.S. manufacturing, producing parts, components and tooling for large manufacturers whose products are sold worldwide. The 381,000 small- and medium-sized manufacturing establishments nationwide (98.7 percent of the manufacturing establishments) employ a total of 11.8 million people (64.9 percent of the manufacturing work force) and account for a combined annual payroll of more than $322 billion (57.2 percent of the manufacturing payroll). Small- and medium-sized manufacturing establishments are responsible for the manufacturing sector's only job growth in recent decades. Manufacturing employment declined by 2.04 million from 1967 to 1992 at larger plants of 500 or more workers. During the same quarter century (1967-92), employment at small- and medium-sized manufacturing plants with fewer than 500 employees grew by 1.71 million. (Date from the U.S. Census Bureau's *County Business Patters 1992: United States* and *Census of Manufacturers, 1967*.)

2. Why Is Manufacturing Extension Necessary? Small- and medium-sized manufacturers often excel in a specific manufacturing process, but many lack the internal staff to master all the dangers and opportunities of performing in the globally competed marketplace. Smaller firms have more difficulty than larger firms in identifying and carrying out high-priority improvement projects. They lack the in-house expertise, time, technical information and funds required to change their operations for the better, according to the National Research Council (*Learning to Change*, 1993).

Many smaller manufacturers have little or no experience working with outside consultants and cannot find appropriate technical experts to provide high-quality, unbiased assistance. Many consultants and consulting firms choose to work with larger manufacturers and ignore the small-firm market because of the high cost of sales involved in identifying clients and providing services to smaller manufacturers, especially those with fewer than 100 employees, the median size of MEP center customers.

The productivity growth of smaller manufacturers lags behind larger firms. Larger manufacturers improved their productivity (value added per hour worked in manufacturing) at an annual average rate of 2.9 percent from 1967 to 1987, the most recent year for which data are available. Small- and medium-sized manufacturing establishments' productivity grew at an annual average of only 1.3 percent during the same years. Small manufacturers are only 69 percent as productive as larger ones, according to the most recent data, down from 79 percent in 1967. (Data from the Census Bureau's 1967 and 1987 *Census of Manufacturers*.)

Market forces alone have not provided smaller manufacturers with all the resources they need to modernize, raise productivity, and make a stronger contribution to living standards and national economic competitiveness. A national network of centers with some public support to extend services to very large numbers small- and medium-sized manufacturers can overcome the cost of sales barrier and enable market forces to drive modernization of the industrial base.

3. What Is the NIST Manufacturing Extension Partnership (MEP)? The NIST MEP is a nationwide network of organizations that provide comprehensive, hands-on, technical support to modernizing small- and medium-sized manufacturers as they upgrade their equipment, improve their production processes, and strengthen their business performance.

The NIST MEP program awards limited federal funding *on a competitive basis* to non-profit manufacturing extension centers that serve firms in specific states and local areas. Each manufacturing extension center tailors its services to meet local needs. The centers provide technical expertise and hands-on assistance for projects relating to appropriate technology, quality assurance, business information systems, production process improvement, plant layout, market development, computer-aided design, computer-integrated manufacturing, waste reduction, material engineering, work force development, rapid prototyping, and other priority manufacturing issues.

NIST cooperates with state governments to set up MEP centers. In many cases, the MEP program builds upon, expands, and enhances established state-level manufacturing extension programs, including some that have been serving smaller firms for decades. But each center is a private, non-profit organization and *not* a part of the federal or state government.

The NIST MEP centers are market-driven -- almost all of them charge affordable fees to customer firms for technical assistance projects. The centers provide assistance broadly to the smaller firms in the manufacturing base of their states and communities. They do not and could not pick winners and losers.

The NIST MEP currently includes 44 affiliated centers located in 32 states and related programs in eight more states. A 1995 competition will add several new centers. A number of these centers are strongly established enterprises; many more are relatively new. The distribution of NIST MEP centers establishes federally supported manufacturing extension efforts in many of America's most industrial states. The 32 states with MEP centers account for 82 percent of all U.S. manufacturing shipments, 81 percent of all U.S. manufacturing employment, and 79 percent of all U.S. manufacturing establishments.

4. Is Manufacturing Extension Working? In a word: Yes. NIST MEP places a high priority on evaluating the impacts of its manufacturing extension centers. Based on early evaluations, the MEP is working very well.

During the program year ending in June 1994, the seven centers founded between 1989 and 1992 carried out some 12,350 services for over 10,000 small- and medium-sized manufacturers, including 2,885 technical assistance projects and formal assessments. The manufacturing firms that provided evaluation data said that they expected each individual technical assistance project, *on average*, to result in:

- $191,473 in increased sales;
- $17,518 in reduced inventory;
- $23,776 in savings from labor and material costs; and
- five jobs created or preserved.

Fifteen months of evaluation data from the seven oldest centers and three months of data from five newer centers show that manufacturing firms are reporting total economic returns of almost $7 for every federal dollar that the centers receive. The economic benefits behind this seven-to-one ratio were calculated conservatively based on what the manufacturers said they expected in labor and materials savings, their reported savings from unnecessary capital purchases that they otherwise would have made, 60 percent of their change in sales, and 10 percent of the value of expected inventory reductions.

In 1994, Dun & Bradstreet Information Services surveyed 750 small- and medium-sized manufacturers that had been customers of MEP centers and 750 small- and medium-sized manufacturers that were not MEP center customers. A study based on this survey found that small- and medium-sized manufacturers served by MEP centers are up to *six times more likely* to organize specific improvement actions than small- and medium-sized manufacturers of similar size, type of operation, and unit volumes not assisted by a center. The planned actions included applying statistical quality control methods, using computer-based information systems, expanding the technical training of workers, and implementing just-in-time delivery procedures.

5. Who Delivers MEP Services to Customer Companies? A substantial majority of the directors, managers, and service-delivering field engineers at MEP centers are seasoned professionals with extensive backgrounds in private, for-profit manufacturing enterprises -- including small- and medium-sized manufacturers. MEP centers also make extensive use of the private, for-profit consultants.

6. Do MEP Centers Compete with Private Consultants Who Might Do a Better Job? Neither companies nor consultants themselves believe that MEP centers compete with private consultants. In fact, they complement private consultant services and enhance the potential small manufacturer market for consultants.

The recent study based on the Dun & Bradstreet Information Services survey confirms that more than 70 percent of the small- and medium-sized manufacturers assisted by MEP centers believe that the centers provide services that either complement the work of private consultants or are otherwise unavailable to the firms. The small- and medium-sized manufacturer customers of MEP centers value their services highly: 72 percent considered the center the only or better source for informal assistance or trouble-shooting at no or little cost; 64 percent considered the center the better or only source to perform cost-effective assessments of operations; 65 percent considered the center the only or better source for unbiased information on all relevant products and services for improvement.

MEP centers often retain private consultants for the project teams that serve customers. Consultants typically lower their rates for such work because they do not incur marketing or sales costs. Small- and medium-sized manufacturers are often reluctant to use private consultants, considering them difficult to find, screen, hire, control, and afford. But 40 percent of the small- and medium-sized customers of MEP centers indicated that working with the center made them more likely to use a private consultant. Nearly three out of four consultants that have worked with MEP centers indicate that the centers' services are beneficial to their businesses.

7. Why Should the *Federal* Government Help Fund the MEP Centers? Strong ongoing federal support for the Manufacturing Extension Partnership is needed to build and maintain the scale, scope, quality, coherence, responsiveness, and strong small- and medium-sized firm focus of the national network. Strong federal support for the MEP will make it possible to:

> Overcome the cost-of-sales barrier to serving very large numbers of modernizing small- and medium-sized manufacturers -- private for-profit providers have not prospered serving small firms because the typical contract is too small to justify the expense incurred in finding and winning the customer;
>
> Reach and assist scores of thousands of small- and medium-sized manufacturers whose improved performance can reverse and close the widening productivity gap between large and small manufacturers, strengthen U.S.-based supplier chains, save jobs, and improve incomes;
>
> Assure that all manufacturing regions of the country have an industrial base of modern small- and medium-sized manufacturers that can defend markets against foreign competition and whose combined capabilities can help anchor the major manufacturers they now have;
>
> Encourage states to invest in improved small- and medium-sized manufacturer performance (a national benefit) rather than intra-U.S. industrial recruitment (at best only a state benefit and often a net national cost);
>
> Reach large numbers of worthy, very small manufacturers whose aggregate contribution to wealth creation and employment is significant but which require more effort to serve than larger firms and are often less able to pay the fully burdened cost of service;
>
> Reach tens of thousands of smart firms in small towns that are often the keystone of the local economy but require more effort to serve than comparable firms in dense industrial metropolises;
>
> Link centers together for consortial learning, benchmarking, timely adoption of best practices and tools through robust cooperation among all centers in the national network;
>
> Deploy to scores of thousands of small- and medium-sized manufacturers the technical standards that are the essential enablers of modern manufacturing -- including the standards, technologies, and knowledge that small- and medium-sized manufacturers need to link into the national information highway;
>
> Develop national and international standards through processes that include the voice of small- and medium-sized manufacturers in the United States;

Respond to unpredictable national security needs that require an agile defense supplier base of small- and medium-sized manufacturers to which national imperatives can be quickly communicated and from which timely performance can be expected; and

Improve small- and medium-sized manufacturers' access to federally funded technology through leveraging national resources such as the federal labs that can make a strong contribution to the modernization of thousands of small manufacturers.

Realization of each of these 11 worthy objectives requires an ongoing federal presence in the partnership. Indeed, the *partnership* is problematic without federal participation.

8. Are Changes in Federal Tax Policy an *Alternative* to the MEP? Wise fiscal policy can be a welcome complement to a nationwide network of manufacturing extension centers but *not* a substitute for the hands-on assistance provided by MEP centers.

Adjustments in the tax code that create incentives for small- and medium-sized manufacturers to modernize may eventually pay for the federal tax expenditure incurred, especially if the strongest benefits are targeted to small manufacturers where slow adoption of modern technology and lagging productivity have hurt national economic performance. The MEP community thoroughly respects the tax policy proposals in *Getting Back to Work*, the recent report of the bipartisan Northeast-Midwest Coalition's Manufacturing Task Force co-chaired by Reps. Franks and Meehan.

It is wrong, however, to force manufacturers to choose between tax breaks and the MEP center services so highly valued by thousands of firms that the MEP network has assisted to date. Well-targeted tax incentives can quicken the pace of technology adoption by small- and medium-sized manufacturers. The benefits of this rapid modernization will be increased for firms, communities, industries, and the nation if thousands of firms get good advice from the field engineers of MEP centers. Tax incentives encourage firms to invest in plant and equipment. MEP centers help modernizing firms to make a wise choice.

9. Why Not Reduce the Budget Deficit by Cutting the MEP? A successful MEP will help reduce the deficit through economic growth. Prospering small- and medium-sized manufacturers will generate taxable incomes and reduce social safety net outlays. By our estimate, increasing the annual rate of small- and medium-sized manufacturing establishments' productivity growth by just *one tenth of one percent* in five years would generate more than *one billion dollars* of additional federal revenue.

There are far better opportunities for deficit reduction than the modest appropriations for the MEP. In FY95, the represented only one tenth of one percent of the federal R&D budget, which is still largely dedicated to the missions of the Cold War era. Unlike most R&D spending, the economic impact of assisting the modernization of thousands of small- and medium-sized manufacturers through investment in the MEP is direct and immediate.

10. How Long Should Federal Funds Support Individual MEP Centers? Federal funds should only help support centers that pass aggressive performance reviews with distinction. The MEP should *never* guarantee permanent federal backing to individual centers.

The trial program that has become the MEP was authorized by the 1988 Trade Act. The primary objective was to transfer new technologies from federal labs directly to small- and medium-sized manufacturers through demonstrations and pilot projects -- a difficult experiment in which each center was properly limited to six years of federal support. Through years of experience in the marketplace serving firms in many different industries in all regions of the country the MEP partners have learned that the more important national mission is continuous deployment of current best practice technologies and methods to many thousands of small- and medium-sized manufacturers. *This* mission evolves as progress redefines best practice. This mission *is* worthy of ongoing federal investment.

Yet nothing would damage the market credibility of MEP centers more than for the national network to devolve toward a stable bureaucracy of entitled fundees. Small- and medium-sized manufacturers would shun the services of such centers. The MEP national network must be as dynamic as the manufacturers it serves. The best means to assure this is to compel centers, by rule or culture, to charge fees for most of their services. Maturing MEP centers are already required to raise a growing proportion of their revenues from non-federal (state and private) sources. If the current authorization in the 1988 Trade Act were amended to allow for federal support beyond the sixth year the amendment should require an aggressive review and competition for funds every two or three years.

The centers that continue to pass muster should continue to receive federal funds so that the national partnership maintains its mission of supporting modernization by small- and medium-sized manufacturers. The cost of sales required to reach very large numbers of small firms remains a barrier that centers can best overcome through public support.

The federal dollars that would fund MEP centers beyond their sixth year could allow those centers to continue to concentrate on smaller firms. Without government support, some centers will survive, but only by moving away from the critical small firm market to seek much larger customers that are less expensive to reach and serve and that can pay fees that reflect the fully burdened cost of the service. The final result might be a few more private for-profit consulting firms competing in a crowded market for the fees of Fortune 1000 manufacturing corporations -- an end far different than the sustained modernization of America's industrial base.

11. Is the MEP a *Government Industrial Policy* Picking Winners and Losers? Not remotely. The NIST MEP program does not pick winners from among technologies, industries, or firms.

MEP centers respond to a broad range of current needs defined by a wide variety of small- and medium-sized manufacturers in a given region. Centers do not bet on the future significance of any still-emerging technology. MEP centers support broad and timely adoption of those technologies and practices that the **marketplace** defines as enablers of competitiveness for specific sectors (e.g. computer-aided design and computer-aided manufacturing in tooling) or major industries (e.g. electronic data interchange in auto) or for all of manufacturing (e.g. Total Quality Management).

MEP centers can only achieve impact through sustained service to a large proportion of the small- and medium-sized manufacturers in their region -- not through focusing their resources on any small segment of manufacturers. Some centers do focus on large and very important industry concentrations in the areas they serve (e.g. aerospace in Los Angeles, auto in Michigan), while also responding at some level to the needs of all firms that seek assistance. MEP centers work with a broad range of customers, offering objective strategic dialogue to leading firms, providing average firms with engineering expertise they do not have on staff, and helping firms in stress define priority problems.

The Manufacturing Extension Partnership is sensible support for America's Main Street manufacturers, not industrial policy.

Program Recommendation

for the

National Institute of Standards and Technology

Advanced Technology Program

Technology for the Genetic Revolution

Submitted by

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Technology for the Genetic Revolution

A technological revolution is occurring that is comparable to the microelectronic revolution or the industrial revolution. This genetic revolution is based upon man's ability to obtain, to understand, to use, and even to manipulate the genetic information in living organisms with the purpose of improving human health and quality of life.

Immediate Goal

Full and rapid progress in the genetic revolution will be made possible by developing our ability to access and manipulate the genetic code of an organism. Therefore, the immediate goal of this program is to develop low-cost methods to determine, analyze, and store an organism's genetic information. Low-cost, high-throughput, high-speed, automated, miniaturized turnkey systems will be critical. Such systems must be easy to use, in the same manner that blood analyzers are now easy to use.

If successful, this project will enable the development of simple processes in which the sample is injected into a cassette, the cassette is placed in a reader, the diagnosis is available on a computer screen and could immediately be transferred to appropriate patient records.

Previous efforts to increase throughput have been based upon direct automation of existing processes (automating people) without considering new paradigms. The proposed program should be directed towards a change in paradigm. It will be based upon new processes and technologies to increase reliability, speed, and to reduce the skill level and amount of manual intervention required to perform genetic analyses.

Applications

Successful completion of this program will both increase our ability to generate new genetic information (HGP and other programs) and our ability to use this genetic information in health care, medical research, agriculture, industrial research and process control, and scientific research. Some applications are listed below:

- Diagnosis of genetic disease, e.g. cystic fibrosis, fragile X syndrome, Huntington's disease, Deuschene's muscular dystrophy, neurofibromatosis, retinoblastoma, Tay-Sach's, Gauchers, hemophilia, ADA deficient SCIDs, sickle cell anemia, and ALS.
- Diagnosis of genetic predisposition to disease e.g. cancer and hypercholesteremia, there by enabling prevention through lifestyle changes.

New Technologies to be Developed

To develop the integrated, miniaturized systems described above, technology development is required in the areas of miniaturized sample preparation and delivery, high-density DNA probe arrays, high-density capillary arrays, low-cost detection systems, data analysis methods for these technologies, and systems integration. These technologies are discussed below in greater detail.

Baseline Technology. There are two assay technologies that are most often used to access genetic information: probe hybridization and electrophoretic separation.

In its simplest application a probe based assay is used to determine if a known a DNA fragment (target) contains a subsequence that is complementary (in the sense of Watson-Crick base pairing) to a pre-selected oligonucleotide probe. This assay is frequently used for the detection of point mutations (ASO, allele specific oligo hybridization) Typically it begins with the preparation of labeled targets in a microtiter format. The target DNA is manually spotted on to filters on which one to fifty of conventionally synthesize oligonucleotides have been immobilized. Depending upon the label, the assay is read by eye, densitometer, beta scanner or fluorescent scanner. Computer based interpretation may be available.

Electrophoretic separation is used to determine the lengths of a mixture of DNA fragments. One of the most common applications is DNA sequencing. The baseline technology for this application is found in many of sequencing centers that are part of the Human Genome Program. Large custom robotic systems transfer bacterial plaques from culture to microtiter plate. Modified commercial pipeting robots perform sample preparation including reagent delivery and temperature cycling. Manual methods are then used to load the samples on to large format gels for separation by electrophoresis. The gels are read by scanning fluorimeters and analyzed automatically by computer to yield raw sequence data. This data typically requires manual editing and semiautomatic assembly and interpretation.

High Density DNA Probe Arrays. These arrays consist of large numbers (hundreds to millions) of different DNA probes immobilized on a substrate (1 cm^2) in a predetermined format where the location of each probe is known. High density DNA probe arrays are used to determine if a DNA fragment contains complements to the immobilized set of DNA probes. Methods of manufacturing high density DNA probe arrays with high fidelity must be developed. These systems must have the following properties, low cost, high feature density, random access (i.e. any probe at any location on the chip), and high fidelity (high probe purity at a single site). Specifically new development is required in the following areas:

- Chip manufacturability: The existing methods of manufacturing high density arrays of DNA probes must be improved to reduce cost, increase synthesis fidelity, and increase feature density.

- New chip synthesis strategies: New synthesis strategies must be developed to reduce cost, permit random access and higher densities.

High Density Capillary Arrays. Capillary arrays are used to separate mixtures of DNA fragments based upon their speed of migration in a polymer matrix. They are currently made by aligning a large number (100) of silica capillaries in a parallel format and providing a method for loading the matrix and the DNA sample. Methods of manufacturing high density capillary arrays must be developed. These systems must have the following features: low cost, high density, low cost gel replacement, and ease of sample loading. Specifically new development is required in the following areas:

- Array Manufacturability: Currently proposed systems use arrays that are manually assembled. The development of low-cost methods for automated assembly and filling of capillary arrays is required. If the cost of manufacturing can be reduced, it would facilitate single use capillary arrays.
- New Array Strategies. New approaches to capillary array implementation that allow significantly higher densities and facilitate automated loading and integration with preparation procedures must be explored.

Sample Preparation and Delivery. Sample preparation systems are needed to perform the necessary biochemical reactions on a sample prior to using either of the assays described above. Typically several steps involving multiple reagents and specified temperature protocols are required. This is followed by the introduction of the sample into the array. These are the most labor intensive steps in using these assays. Existing efforts to automate these steps (mostly taken at large scale academic sequencing centers) have been based upon direct automation of existing manual procedures. Many are based upon the use of high density micro-titer plates and automated pipeting robots. New developments are required in the following areas.

- Simplification of protocols. One immediate means to reducing the cost of sample preparation is to simplify the protocol. For example, most current protocols for using DNA probe arrays require lysis, protein digestion, amplification and labeling. If high sensitivity direct detection (see next section) were available, the amplification and labeling steps could be eliminated.
- Miniaturization of protocols. Formats must be developed for the execution of sample protocols a very low volumes. Existing methods fail as evaporation losses and sample handling inefficiencies accumulate. These same formats must easily allow parallelization and automation to achieve high throughput.
- Sample Delivery Integration. Efficient methods of delivering these highly parallel miniaturized samples to the capillary arrays and the DNA probe arrays must be developed.

Success in this part of the proposed program will yield technologies that are applicable beyond DNA probe arrays and capillary electrophoresis. There is potential application to sample preparation in most any chemical or biochemical assay.

Low Cost Detection Systems. Detection systems are used detect the presence or absence of DNA hybridization events on a DNA probe arrays. Similarly they are used to detect the migration rates of the DNA fragments in capillary arrays. New detection systems must be developed. These systems must have lost-cost, high sensitivity, ease of use, high speed, and be easily integrated with the arrays. Specifically new developments are required in the following areas:

- Fluorescent Detection: Existing systems for both capillary and DNA probe arrays are based upon laser excitation and solid state detection of fluorescent reporter groups. Lasers are currently a significant part of the cost of these systems. Low cost systems of solid state lasers and corresponding dyes must be developed. Current systems are based upon a point scanning format, new high speed parallel formats are needed.
- Other Detection Systems: Detection systems based upon other kinds of reporter groups or based upon direct detection of DNA (capillary arrays) or duplex formation (DNA chips) must be developed.

Success in this part of the proposed program will yield technologies that are applicable beyond DNA probe arrays and capillary electrophoresis.

Data Analysis/Databases. Currently there is limited software available for the application of DNA probes arrays and capillary arrays to biological assays. New software is required in the following areas:

- Computer Assisted Probe Array Design (CAPAD) Software: The effectiveness of high density arrays of DNA probes is dependent upon the length and base composition of the probes used. Software to optimally select these probes must be developed. In addition, certain probe configurations may allow more efficient manufacture. Software to select these configurations must be developed.
- Data Analysis: The two assays described above measure complementary aspects of DNA fragments. New data analysis methods to exploit this complementarity are necessary to fully integrate the use of the both assays and to extract the maximum amount of information.
- Databases: Methods of efficiently storing, retrieving and analyzing the raw and processed data from DNA probes array experiments and capillary array experiments will be required. For example, DNA probes will enable the rapid resequencing of one or more whole genes or regions of genes from an individual. These assays when applied broadly to the population will yield large amounts of sequence data that is highly redundant. Methods of efficiently storing, retrieving, and analyzing this data are required.

Integrated Systems. The components described above must be integrated. Phyiscal integration of the systems will reduce handling and associated labor costs and the required sample volumes. In addition, integrated system often have low production costs since there are few components. Existing systems for electrophoresis and DNA probe arrays have effectively integrated the assay, the detection system, and the software. The critical area for development is the integration of sample preparation with the assays themselves, i.e. sample delivery. This is addressed above as part of sample preparation.

New Industrial Capabilities To Be Achieved

Successful completion of the proposed program will demonstrate the following industrial capability: Manufacture of low cost integrated systems for acquiring and analyzing genetic information including one or more of the following components:

- miniature sample preparation and delivery devices,
- high density arrays of DNA probes,
- high density capillary arrays,
- detection systems, and
- data analysis, storage, and retrieval.

Four Criteria

ATP programs will be selected based upon their satisfaction of four major criteria:

- Potential for U.S. economic benefit
- Good technical ideas
- Strong industry commitment
- ATP funding will make a difference

In the following sections we address how the proposed program will satisfy NIST's four criteria:

Potential for US Economic Benefit

The proposed research will provide clear economic benefit to the United States. The primary path to economic benefit is by providing the U.S. with a proprietary position in a unique series of new technologies that will be critical to accessing and analyzing genetic information. Products will be developed for the diagnostic, industrial markets, and scientific research. These products will enable the applications described above. The development, manufacturing, marketing, distribution, sales, and servicing of these products will yield large numbers of new jobs for U.S. workers. The applications themselves will lead to further economic benefit. These benefits are described below:

Health Care. These products will improve and lower the cost of healthcare. This will occur by several means including the following:

- Reduction Of Testing Costs. A high density DNA probe array will allow the development of broad spectrum and highly specific diagnostic panels for genetic and infectious disease. For infectious disease, these tests will reduce the need to culture samples or run many immuno-diagnostic tests. For genetic disease, these tests will increase certainty by allowing parallel testing for many defects at once in a single gene, and allow parallel testing for multiple diseases.
- Improved Therapeutic Management. Accurate DNA based diagnosis of infectious disease and cancer will allow more accurate selection of therapeutics, this will lead to more efficacious treatment, reduce the loss of patient productivity, lower treatment cost, and reduce the development of resistant strains of infectious agents. These same benefits will accrue for genetic disease as new treatments are developed.
- Prevention. Knowledge of a genetic predisposition will allow prevention through behavior modification reducing down stream healthcare costs.

Large Scale Sequencing Projects. Large scale programs are underway to sequence the genomes of humans, several model organisms, rice and corn. The proposed program will provide important products that will significantly improve our ability to execute these large scale sequencing programs. Knowledge of these genomes will provide the U.S. with a significant competitive advantage in the development of diagnostics, therapeutics, genetically engineers foods, and novel enzymes and organisms for industrial processes.

Agribusiness. Plant and animal breeders have historically been significant users of genetic information. The ability to access genetic information such as genetic markers will enable more rapid and accurate breeding programs and yield higher value agricultural products.

Industrial Process Control. Many modern industrial processes, particularly in the food and drug manufacturing areas are dependent upon the use of large cultures of genetically engineered organisms. The proposed program will lead to new products to monitor the status of such cultures.

How Important Are Industrial Sectors.

These industrial sectors are important to the U.S. economy. Health care costs currently account for 13% of the gross domestic product. Currently United States pharmaceutical corporations account for an estimated $24.7 billion in foreign sales of pharmaceutical products and another $6 billion in *in vitro* diagnostic sales. U.S. firms account for almost half of the world-wide sales in health care products. This leadership position is to a very large extent maintained by intellectual leadership in emerging fields such as biotechnology and human genetics. Without sustaining investment to maintain the U.S. infrastructure, this lead will be lost to foreign investment from Japan and Europe.

Can Industry Commercialize Ideas?

Industry will commercialize the products that come out of the proposed research. Organizations for research, manufacturing, marketing and sales of the products that will come out of this program are already in place at many companies. In particular, several companies are already marketing tools to access genetic information (ABI, Pharmacia, Millipore for sequencing, Roche and Cetus for probe based genetic diagnostics). Molecular Dynamics is developing a sequencing instrument based upon capillary electrophoresis. Affymetrix and Beckman instruments are developing diagnostics based upon DNA probe arrays. The technologies that result from the proposed program will be the basis for new products for these organizations. In addition, significant interest in these technologies has been demonstrated by several large diagnostic companies.

Good technical Ideas

The proposed program is based upon good technical ideas. These are ideas that have the potential to bring about fundamental changes in how genetic information is accessed and analyzed. While there are technical barriers, there are technologies to overcome these barriers. These ideas provide the opportunity to leverage areas in which the U.S. has already established technological leadership.

Revolutionary programs - potential to bring fundamental change. The proposed program has the potential to revolutionize the manner in which genetic information is accessed. Consider the example of genetic diagnostics. Current methods of detecting mutations in the p53 gene (important in many cancers) is based upon PCR amplification followed by sequencing. This process requires many manual steps that must be performed by skilled technicians. Current efforts at large sequencing centers to automate these projects are based upon parallelizing the existing protocols.

Barriers and Innovations. The principal barriers to this program are listed below:

- **DNA arrays:** reduce cost, increase density, improve quality.
- **Capillary Arrays:** reduce cost, increase density, develop easily replaceable or inexpensive disposable arrays.
- **Detection system:** low cost blue green lasers and well developed systems of red dyes
- **Sample Preparation and Delivery:** miniaturization, parallelization, and integration.
- **Data Analysis and Storage:** new algorithms and storage methods.

The specific innovations required to address these barriers are proprietary and will be addressed in a our response to the proposed program.

Validation. The proposed technologies must be validated in the context of one of the applications. The two most appropriate application cited above are large scale sequencing and clincial diagnostics. Testing these technologies in the context of a large scale sequencing project will demonstrate their effectiveness when compared with the state of the art in DNA sequencing. It will specifically allow issues of cost, and throughput to be evaluated in an end to end fashion. In addition, as the technologies are incrementally brought on line, the can be integrated into an existing process and evaluated. Similarly, testing in the context of clinical diagnostic will also address issues of cost and additionally ease of use by less skill operators.

Strong industry commitment

Affymetrix and MDC, two leading companies in the development of new technologies for genomics are already cooperating in areas of common interest. We are developing collaborative relationships with researchers at the University of Washington (Lee Hood), Stanford University (Ron Davis), Lawrence Berkeley Laboratory (Jasper Rine) and the University of California, Berkeley (Rich Mathies) to support this program.

ATP funding will make a difference

The establishment of an Advanced Technology Program in genetic technologies will be critical for the commercial development of this area. The NIH National Center for Human Genome Research and the DOE Office of Health Effect Research are investing in the development of new DNA sequencing and analysis technologies. In addition to supporting the enhancement of the technology base in NIH and DOE genome labs, this funding has catalyzed the emergence of second generation DNA sequencing and analysis technologies such capillary arrays and DNA hybridization chips. The full development and integration of these feasible second generation technologies into a new paradigm for gene sequencing and analysis will require a substantial investment in additional research and development. This investment is well beyond the current funding capabilities and goals of the DOE and NIH. The proposed program will make a unique contribution to this development at a critical time.

Programs such as these pose significant technical risks with payoffs far enough down the road that most sources of private, public, and venture capital are reluctant to fully fund the research. In paticular, companies such as our own will not be able to aggressively pursue this areas without ATP support.

This is an area of high leverage. While some of the greatest payoffs will come when the HGP is completed, completion of the proposed program will help to accelerate the HGP. In addition, the need for the technology is growing exponentially as new sequence is generated and function is elucidated.

This field is quite competitive with research going on in the U.S., the UK., Japan, and Russia.

We believe that programmatic funding at the level of $50 million each year will enable this program to succeed.

See pages

ADVANCED TECHNOLOGY PROGRAM: AN OVERVIEW

Begun in 1990, the Advanced Technology Program (ATP) at the National Institute of Standards and Technology (NIST) promotes the economic growth and competitiveness of U.S. business and industry by accelerating the development and commercialization of promising, high-risk technologies with substantial potential for enhancing U.S. economic growth.

The program provides technology development funding through cooperative research agreements to single businesses or industry-led joint ventures. Applicants must share the costs of ATP projects.

Awards to individual companies are limited to $2 million over 3 years and can be used only for direct R&D costs. Awards to joint ventures can be for up to 5 years; joint ventures must provide more than 50 percent of the resources for the project. The ATP does not fund product development. It will support development of laboratory prototypes and proof of technical feasibility but not commercial prototypes or proof of commercial feasibility.

The ATP relies on the substantial involvement of industry to define and implement R&D programs that are expected to have a substantial long-term economic impact. The ATP selects specific projects through a rigorous competitive process that includes evaluation of both the technical and business merits of a project. The program has received broad public support from groups such as the Advanced Technology Coalition, which represents over 30 major trade associations, professional societies, and high- technology companies.

Essential Features

In designing the ATP, NIST looked to existing large-scale R&D funding programs with a reputation for results, particularly those of the National Institutes of Health and the Defense Department's Advanced Research Projects Agency. But the unique mission of the ATP—support for civilian technologies in the nation's competitive interest— required some special features, which have become the hallmarks of the ATP and major factors in its success.

Projects are selected on the basis of both technical and business merit through a fair and rigorous competition.

After each proposal is screened for basic compliance with the ATP's requirements, it is reviewed thoroughly by scientists and engineers expert in the subject area—a common procedure for competitive grant programs. But ATP proposals that score well in this technical review go on to a *further* evaluation of potential economic impact, evidence of significant commitment to the project on the part of the proposer, and other business-related factors affecting the likelihood that successful results will be commercialized.

The scientific and technical reviewers are primarily federal and academic experts to avoid conflict-of-interest problems and protect proprietary information. Business reviews are conducted primarily by business experts from the private sector who agree to avoid conflicts of interest and abide by non-disclosure requirements. Semifinalists receive in-depth oral reviews. Proposals are ranked according to published selection criteria, and funding is awarded primarily on the basis of the ranking. This merit-based selection process has been fully tested and refined and is essential to the effectiveness of the ATP.

The ATP provides direct support to for-profit companies of all sizes.

Commercial organizations know best how to commercialize a promising new technology. With this in mind, the ATP emphasizes direct funding to for-profit companies. Small, medium, and large companies, and joint ventures led by two or more companies, are eligible for direct funding. Successful ATP project sponsors range in size from start-up companies with a handful of employees to major industrial firms with international scope. Universities, federal laboratories, and non-profit institutions participate in many ATP projects, but as subcontractors or as members of joint ventures (although non-profit institutions may administer joint ventures).

PAST AWARD WINNERS

A listing of the research goals for past ATP award winners covers a very broad array of cutting-edge technologies.

A sampling of 1992 winners includes multiyear awards to help fund:

- development of thick-film processing technology for radio-frequency components for communications equipment (such as cellular telephone base stations), based on high-temperature superconductors;
- development of technology to "clean" semiconductor wafers of trace metals, particles, and surface damage using dry, gas-phase agents in lieu of wet chemicals;
- demonstration of a revolutionary new design for high-precision, multi-axis machine tools, based on an octahedron frame and a "Stewart platform" actuator;
- improvement in scientific understanding of the relationship between processing, part geometry, microstructure, and part performance for fiber-reinforced molded thermoplastic parts, and application of this knowledge in an integrated thermoplastic engineering design morphology.

The ATP has a broad mission to promote large economic benefits for the nation.

The legislative mandate of the ATP is to promote "commercializing new scientific discoveries rapidly" and "refining manufacturing practices." This offers tremendous scope. The objective of some projects is to develop technologies that enable lower-cost, higher-quality, or faster-to-market products. The ultimate objective of others is to develop the know-how to provide new-to-the-world or radically improved products and services. The ATP has a high potential impact on U.S. economic growth because, unlike other federal technology programs, it makes investments explicitly for this reason rather than for some other national goal.

The ATP is market-oriented.

While government provides the catalyst — and in many cases, critical technical support — industry *conceives, manages, and executes* ATP projects. Management of projects is geared to ensure that the work performed is what industry believes should be done and is what it can do best.

The ATP also emphasizes cost sharing — ATP recipients on average pay more than half the total costs of the R&D. This helps ensure that companies have a vested interest in the success of projects and in timely commercialization. At the same time, participation by small companies and start-ups is not precluded, because the single-applicant requirement for cost sharing is that the company cover its indirect costs. Since most start-ups and small companies have low indirect cost rates, this requirement is not prohibitive.

- development of a microfabricated chip incorporating synthetic DNA probes, together with necessary sensor and computer technology, for an automated, low-cost DNA sequencer;
- creation of a generic software technology to restore, enhance, or digitally reformat moving pictures, such as sequences from infrared, ultrasonic, or X-ray sensors or motion-picture films;
- application of newly developed production technologies to fabricate high-efficiency long-lived, blue/green lasers and LEDs;
- development of new rapid solidification casting technology to produce thick ribbons of metallic glass sufficiently ductile to be used in high-power electric transformers and motors to reduce wasteful power loss;
- development of the methodology for producing animal-derived extracellular matrix materials as prosthetic materials to support the regeneration of tissues and glands; and
- demonstration of the use of quantum-level "electron trapping optical memory" in a prototype erasable optical disk drive suitable for digital video recording at substantially higher speeds and greater densities than existing optical storage media.

The ATP has a comprehensive plan for monitoring and evaluating its performance.

From the start, the ATP has strongly embraced program evaluation and considers it critical to the development and operation of a results-oriented, efficiently run program. Early on, an evaluation plan was developed and measurable goals were identified against which to track performance. As the ATP strategic plan is updated, the evaluation plan is revised to ensure that it covers all critical aspects of the program.

Economic Returns

Early results indicate that the ATP is successfully improving the capability of the nation's businesses to capture economic returns from scientific and technological innovations. Two independent studies of projects funded in FY 1991 revealed substantial, early beneficial impacts on participating companies, including:

- expanded R&D activity, particularly the ability to engage in high-risk, long-term research with high-payoff potential;
- cost and time savings, improved productivity, and other benefits from industry-industry, industry-government, and industry-university collaborations;
- improved competitive standing;
- formation of valuable strategic business alliances;
- improved ability to attract investors;
- assistance in converting from defense to commercial applications; and
- acceleration of technology development, leading to improved market share.

General and Program Competitions

The NIST ATP office conducts competitions each year to review submitted proposals and select grantees. The number of projects funded varies with the total program budget.

Two types of competitions are supported: "general" and "program." General competitions are open to all technology areas. Past general competition awards have covered a very broad spectrum of technologies in agriculture, biotechnology, microelectronics, machine tools, advanced automotive manufacturing, advanced materials, information and communication technology, flat-panel display manufacturing, and other areas. (See box above.)

Each program competition focuses on a set of technology and business goals. Program competitions enable the ATP to channel significant support to clusters of related projects, each attacking a critical element and reaping the benefits of this synergy.

Key criteria for selecting program areas include:

- potential U.S. economic impact, including the credibility of the program's proposed pathways to economic growth; the importance of the existing or potential sector affected; and the probability of subsequent commercialization;
- good technical ideas that are "cutting edge," high risk, strategically important, and based on sound scientific and technical concepts;
- strong industry commitment to participate, including breadth and depth of interest and willingness to share costs and to work with the government and other partners; and
- opportunity for ATP to make a major difference by supporting work that is unique or complementary to other industrial and government efforts, that offers timely and significant acceleration of research progress, and that requires a critical mass of funding.

Industry Input

In selecting these broad programmatic areas, the ATP relies on its overall strategy of drawing on industry's ideas. Setting research priorities is a constant, ongoing process based on input from industry. Every program has a finite duration, so there is a constant turnover of programs as some are completed and others started.

Mechanisms for getting industry's input include (among others):

- input from senior industry technical and business managers;
- input from industry associations, trade groups, and professional societies;
- ATP-sponsored technical workshops and conferences; and
- analysis of proposals submitted to ATP in previous competitions.

Beginning in FY 1994, NIST also plans to amplify the ATP's impact on the U.S. economy with several new strategies.

It will take a more active role in building cooperative programs among businesses, universities, and government agencies.

Because of its global view and broad sources of information, the ATP is in a unique position to spot potentially advantageous alliances and bring them to the attention of its industrial partners. For example, the ATP might bring to the attention of a joint venture an outside company whose proposed work appears to mesh well with that of the joint venture. Or the ATP might suggest a strategic alliance between a single-company applicant proposing to develop a new technology and a potential end user of that technology, if such an alliance would increase the chances of a project's success.

Although the final decisions about such alliances will always lie with the companies, recognizing such opportunities gives the program an additional tool to increase the chances of success for its projects and to exploit promising opportunities that emerge.

ATP will assist companies in planning for future commercialization and in developing linkages with investors.

Many of the companies participating in the ATP—particularly small companies—are stronger in their R&D planning and implementation of the R&D plan than they are in their business planning and implementation of that plan. The early-stage, preliminary business plans developed by these companies in their ATP applications often lack sufficient detail to provide the clear path to commercialization required by the ATP and may jeopardize many highly promising projects. The ATP plans to contract with private firms to provide business development support to ATP-funded companies that need such assistance.

The commercialization assistance program will be run initially on a trial basis. Its performance will be monitored and evaluated, and, if successful, it will be continued and expanded to serve all companies that wish to participate.

The program will intensify its outreach efforts.

While well-known to most of the larger technology-oriented companies in the United States, the ATP is less well-known or understood by thousands of small, entrepreneurial companies that play a critical role in technology development and might benefit from its programs. To remedy this, an intensified outreach and marketing program has been started to increase awareness of the program. The outreach program will be coordinated closely with state and local economic development organizations that are in a good position to identify small companies that might have an interest in the ATP.

President Clinton has proposed major increases in ATP funding to increase the number of awards made each year and the breadth of cutting-edge technologies covered. The proposed expansion will allow the program to have a truly national impact on economic growth. The program's ultimate success, however, will depend on continued contributions from U.S. industry in the form of good technical ideas, a willingness to cost share, and the successful commercialization of new technologies developed with ATP funding.

Contact:

Advanced Technology Program
1-800-ATP-FUND (1-800-287-3863)
email: atp@micf.nist.gov
fax: (301) 926-9524

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ADVANCED TECHNOLOGY PROGRAM: A "HOW-TO" GUIDE FOR SUBMITTING PROGRAM IDEAS

The Advanced Technology Program: What it is, What it does.

The Advanced Technology Program works with U.S. industry to advance the nation's competitiveness — and economy — by helping to fund the development of high-risk but powerful new technologies that underlie a broad spectrum of potential new applications, commercial products, and services. Through cooperative agreements with individual companies or groups of companies, large and small, the ATP invests in industrial projects to develop technologies with high-payoff potential for the nation. The ATP accelerates technologies that — because they are risky — are unlikely to be developed in time to compete in rapidly changing world markets without such a partnership of industry and government. By sharing the cost of such projects, the ATP catalyzes industry to pursue promising technologies.

Managed by the National Institute of Standards and Technology, the ATP has a unique set of features that distinguishes it from other technology development programs in the government. These include:

✔ Our focus on economic benefit: ATP projects are selected explicitly for the greatest possible benefits to the nation's economy — innovative technologies that can be expected to lead to new or improved world-class products and industrial processes.

✔ A rigorous, competitive selection process: project proposals are evaluated for both their scientific and technical merit *and* the business and economic merit of the proposed use of the technology.

✔ Industry orientation: ATP projects are conceived, proposed, managed and executed by private industry in response to its analysis of market opportunities. Industry shares in the cost of the projects.

Programs: A New Direction for the ATP

Started in 1990, the ATP holds great potential to be an effective, highly productive element of the nation's technology strategy, but now we must fulfill that potential. The challenge is to scale the ATP to a major national program while retaining its essential characteristics of objectivity, fairness and efficiency.

To date, the ATP has used general competitions open to proposals in all areas of technology as its sole investment mechanism. As it grows to a full-scale activity, the ATP will be able to deepen support in selected, well-defined program areas while continuing to provide an open door to promising ideas from any area of technology. While the Administration's target budget of $750 million in 1997 represents a significant increase for the ATP, it is still less than one-half of one percent of the nation's R&D budget. The effect of the ATP will be far too dilute if it is spread evenly across every area of technology.

Each program will have well-defined technological and business goals. Often, these will involve the parallel development of a suite of interlocking R&D projects. By managing *groups* of projects which will complement and reinforce each other, the ATP will be able to have the greatest possible impact on technology and the economy. Specific program areas will be selected based on ideas from industry to preserve the strongly industry-oriented outlook which has characterized the ATP from its start. Under each program, individual ATP *projects* will still be selected under the competitive process we have established.

These programs are not open-ended. We anticipate that a typical program will run five or more years with an end-date defined up front. We expect that typical programs will require about $20 to $50 million per year from the ATP. These are only rough estimates. Both the duration and level of funding will depend on the scope of the program as it is defined in cooperation with industry.

Programs: What are we looking for?

ATP programs will be selected on their match to four major criteria:

- ✔ Potential for U.S. economic benefit.
- ✔ Good technical ideas.
- ✔ Strong industry commitment.
- ✔ The opportunity for ATP funds to make a significant difference.

Following ATP tradition, we intend to select program areas based on suggestions from industry — where do *you* think we should invest? Send us your suggestions.

You should state as succinctly as possible theimmediate goal of the proposed program: the technology(ies) to be developed, the new industrial capabilities to be achieved. Then discuss briefly how this is to be done, and how these goals address our four criteria.

The following guidelines will help you address the criteria. We recognize that you may not have enough information at first to answer all these questions, don't let that stop you from sending in a suggestion. If an area sounds promising, we will work with you and others to refine the program. But the more information you can give us at the beginning, the better we'll be able to evaluate the proposed program. The examples are for *illustration only*: we have no prejudices for or against the technologies mentioned.

Potential for U.S. Economic Benefit

The whole point of the Advanced Technology Program is to foster significant economic benefits for the country.

Trace the path by which the technical developments under the proposed program will lead to significant economic benefits for the nation. Give us a logical explanation of how the proposed program will lead to economic growth. How should the R&D program be directed to support the economic goals? How will this be reflected in integrated research and business strategies? What will be the likely effect on the U.S. workforce if the program succeeds and is carried forward to commercialization? How can the proposed program lead to economic growth, with a focus on a rising standard of living? What effect would an ATP program likely have on commercial prospects for this technology — taking into account national and international considerations?

How important to the economy are the industrial sectors that would be most affected by your program area? How important could they be if the program succeeds? Give evidence that the sectors of the economy that will be affected are either sufficient to generate large national economic benefit, or that they are strategicallyimportant in some other way — perhaps improvements in that sector enable large economic benefits in other sectors. What advantage would the proposed technology confer? A major technological advance in a relatively small industrial sector could be as advantageous as a lesser advance in a much larger sector. And vice versa.

When you are estimating economic benefits, identify the production and distribution industries and the end-use markets that would be affected, and discuss the expected impacton employment and the gross domestic product. If the purpose of the program area is to develop new industries and markets, assess their potential.

Example

Potential for U.S. economic benefit:
In the laboratory, scientists can make concrete which is ten times stronger and more durable than what is currently used in construction. A five-year program to translate laboratory work to, say, a five-fold improvement in commercially available concrete might require parallel work in manufacturing, distribution, and construction techniques — requiring participation by cement companies, add-mixture companies, ready-mix companies and contractors — as well as revision of state and local building codes and other non-technical barriers. But it might create a revolution in construction practices. Structures might be designed to be twice as strong with less than half the concrete.

What would be the economic impact of such a program? Expanded U.S. presence in a market dominated by foreign firms? Improved competitiveness for U.S. construction firms bidding on international products? Expanded concrete markets in general, because stronger, more durable concrete could be used in more applications? Greater productivity in the construction industry, because the new concrete cures faster, and at lower temperatures (extending the construction season)? What industry alliances would be necessary to move technological advances rapidly into the market?

Will industry be able to commercialize the results of the proposed program? There should be a high probability that commercial products or processes will follow successful completion of the R&D. You should assess industry's commitment to the proposed program area. Will it follow through on commercialization? What are non-technical barriers to commercialization, both at home and abroad, and how will they be overcome? We will expect you to consider *all* of the critical elements that affect the program area, not simply technological challenges. What effect would an ATP program likely have on the commercial prospects of this technology?

Good Technical Ideas

We are looking for revolutionary programs with the potential to bring fundamental change to industry.

Example

Good technical ideas:
What is the technology "baseline" for your proposed program area? Suppose the suggested program deals with significant advances in digital data storage, a $50 billion-per-year industry requiring a broad range of technologies, including architectures, media, manufacturing methods, and error correction algorithms. Industry already sponsors significant, highly successful, research efforts in these areas. How is data storage *expected* to improve as a result of the efforts of industry and existing government programs? What might the ATP add to this?

What are the major technical barriers to be overcome? What innovative technologies will erase those barriers?

We welcome "cutting-edge" technologies that entail a high degree of technical risk. We are looking for "technological nonlinearities" — opportunities for a relatively small research effort to leverage major advances for an industry.

What is the current state of the art for this technology, and what are the technology trends? How do you expect the technology to advance, based on industry investment, without the ATP? How will this be accelerated or changed by establishing an ATP program?

Give evidence that the proposed R&D is founded on sound scientific and technical grounds.

Strong Industry Commitment

We intend these programs to be *partnerships*. Give evidence that a reasonable segment of the industry is ready and willing to work with the ATP and with one another as needed to achieve the program's goals. Would the program require horizontal alliances? Vertical alliances? Both? Are the industry players prepared to build these relationships?

> **Example**
>
> ***Strong industry commitment:***
> Introducing large-scale use of strong, lightweight advanced materials in automobiles and trucks probably would involve developments in materials design, manufacture, and fabrication and assembly. To be effective, such a program might require the cooperation of a significant number of raw materials suppliers, component manufacturers, and suppliers, as well as major automobile manufacturers. In evaluating such a proposal, we would look for evidence that these firms were ready and willing to work together on related projects, and to share the costs with the ATP.

Give some measure of the breadth and depth of industry's interest in the proposed program. Describe industry's willingness to share the costs of the R&D. Estimate the level of resources that industry is likely to put towards the proposed program.

Opportunity for ATP Funding to Make a Significant Difference

In other words, why the ATP? Is the proposed program unique? If not, what related efforts are underway, either by industry or government? How would the program complement these efforts?

> **Example**
>
> We won't duplicate other Federal investment, but we are open to ideas that complement existing work. The Defense Department's Advanced Research Projects Agency has substantial programs with industry in several dual-use areas of electronics technology: packaging and electronic interconnects, displays, semiconductor manufacturing, low-power electronics. A group of companies might propose an ATP program that focuses on the systems integration of these and other advanced electronics technologies in order to explore creative new personal electronic systems, an area that they deem to be of significant commercial potential. An ATP program in this area would be defined and executed in a manner that complements the ARPA investments and builds on them to pursue applications that are promising from the perspective of economic growth.

One reason for the ATP to back an area is to provide the critical mass of support and funding necessary to accelerate work in hotly competitive fields. What is the international competition? Is time of the essence?
Can we realistically hope to meet the program goals? Remember our time and money constraints — roughly five or more years and about $20 to $50 million per year per program. Will the combined industry and governmentfunding be adequate to exploit the technological opportunity in the critical time frame?
To achieve significant economic impact, the ATP's funds must be highly leveraged. If the program is successful, will our relatively small investment lead to far greater investment by industry in subsequent development and commercialization?

Explain why federal funding in general, and ATP funding in particular, is needed in order to achieve the large potential economic benefit to the nation.

What Happens to the Suggestions?

ATP will acknowledge receipt of all program ideas, and log a summary and information on the submitting organization(s) in a computer database. ATP technical and economic assessment staff will review the ideas and consult with outside experts. We anticipate receiving some fully developed program ideas that provide information addressing all of the program criteria. In other cases, we expect to receive incompletely developed ideas or complementary ideas that need to be woven together into a more complete and cohesive program. ATP program managers will be responsible for further developing program ideas, weaving together interrelated ideas, and working with industry to define robust programs.

The program planning process will include defining specific technical and business goals and developing a program plan for achieving those goals. Program managers may use a variety of mechanisms to develop programs including public workshops, informal meetings, data collections, analytical studies, etc.

We expect to carry out a number of program planning activities in parallel. All program ideas are not expected to be incorporated into programs and all planned programs are not expected to be funded. The NIST Director andthe ATP Director will assign priorities and allocate available funds among programs on the basis of how well the proposed programs meet the four selection criteria.

Executing an ATP Program

When funding for a new program is approved, we will publish a proposal solicitation announcement in the *Federal Register* and/or *Commerce Business Daily*. Multiple competitions over several years may be held for each program. Competitions would generally be expected to result in multiple awards to both single-company and joint-venture applicants. The proposal solicitation for each competition will describe the specific technology areas covered by that competition, and the program's technology and business goals.

Program competitions will follow the established rules and procedures for all ATP competitions. Legislatively mandated limitations on eligibility of organizations, cost-sharing, funding ceilings, and duration of awards for single-company applicants and joint ventures will be the same as for general competitions. Proposals will be accepted only in response to formal solicitations. Awards will be made only through these competitions.

Building on our present approach, we will actively manage for success but we will not micro-manage. We will work continuously to minimize bureaucracy and paperwork. We aim to help awardees to create linkages to other organizations that might enhance project success. Our management approach will be to add value by asking questions and not by imposing solutions. Our goal is to manage so that program results are greater than the results of individual projects.

Choosing Program Areas: Make Your Voice Heard

The ATP depends heavily on inspiration and input of a constant supply of good ideas from industry. Here's how to make your ideas heard:

- ✔ Draw up a letter or short "white paper" (no more than 10 pages, please) describing the program idea.
- ✔ Clearly state the technical and business goals that should be achieved by the end of the program. Outline the R&D plan.
- ✔ In the letter, discuss how the proposed program meets the criteria detailed above. Address as many of the points as possible, but don't let incomplete information stop you from sending in the suggestion.
- ✔ Think you can pose better questions for evaluating programs than we have? Feel free to send them in — we are continuously refining our process.
- ✔ Do NOT include any proprietary information! Expect your letter to be widely copied, circulated and discussed.
- ✔ Send it to us. Your choices:

  Mail: Program Ideas
  Advanced Technology Program
  NIST
  A430 Admin. Bldg.
  Gaithersburg, MD 20899-0001

  Facsimile: 1-301-926-9524

  E-Mail: atp@micf.nist.gov
- ✔ For general information and to get your name on the ATP mailing list (but *not* to make your suggestion), call 1-800-ATP-FUND.
- ✔ Recommendations may be submitted at any time — the sooner the better.

NIST
UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899
OFFICE OF THE DIRECTOR

March 24, 1995

Honorable George E. Brown, Jr.
Ranking Democratic Member
Committee on Science
House of Representatives
Washington, D.C. 20515-6301

Dear Mr. Brown:

In response to your request, I wanted to provide you with some examples of the game-changing R&D we are jointly supporting with industry through the Advanced Technology Program (ATP). To that end, I am enclosing descriptions of two ATP projects and one of our focused programs.

Real technological revolution doesn't happen very often. It can occur in small, medium, or large companies, and the ATP seeks out the most promising opportunities to make a difference regardless of where they occur. As I mentioned to you, half of our ATP awards have been to small businesses or joint ventures led by small businesses. Frequently, small startup businesses are unsuccessful in obtaining private-sector funding because the technologies they want to explore are judged by private investors to involve too much technical risk. So, without ATP, their clever ideas might not be pursued.

But it is not only small companies that find it difficult to obtain funds for risky R&D. In fact, it is often as difficult for a scientist or engineer working in a Fortune 500 company to convince risk-adverse corporate management to fund a radically new approach as it is for the small company entrepreneur to secure funds. The ATP encourages companies of all sizes to look much further out than their typical short-term time horizons, and to accept considerably more technical risk than they would otherwise, in return for significant potential economic benefit down the road.

For example, the principal investigator for Armstrong's ATP project, Dr. Arthur Yang, had been trying to convince his management for some time to fund a project to explore a radically new approach to thermal insulation technology. It was considered (rightly so) to be a "far-out" approach. Like all well-established companies, Armstrong has an obligation to its stockholders to maximize short-term profitability, which results in an emphasis on low-risk, incremental product upgrades in setting R&D priorities. But Yang persevered, and convinced Armstrong to share the cost with ATP. Now that the project is underway and making good progress with joint support, Armstrong's upper management is excited about the potential. But prior to the ATP, it was not happening. This scenario is played over and over again in ATP projects.

We are the only federal R&D program that I know of that is making a conscientious and rigorous effort to quantify the program's return on investment to the U.S. economy. We recently convened a panel of the country's most prestigious economists involved in assessments and asked them to critique our measurement methodology for ATP. The primary goal of the ATP, and the real payoff, is the economic growth in the future that will come from the introduction of new products and industrial processes based on ATP-supported R&D. We can already track some early indicators that the ATP projects are on course and the economic potential is building. I firmly believe that ATP will demonstrate the highest economic bang-per-buck of any part of our federal R&D investment in the long term.

Our experience is that the more people find out about how the ATP actually works, the better they like, whether they be Democrats or Republicans. President Bush's Science Advisor Bromley came to be a firm believer in the ATP and continues to advocate for it. Former Secretary of Commerce Barbara Franklin, Deputy Secretary Thomas Murrin, and Under Secretary for Technology Robert White all continue to endorse the ATP.

Also enclosed is a set of questions and answers about ATP that respond to the most frequently asked questions and most frequently raised concerns about the program. I think you will find it helpful as a quick reference.

Thank you for your continuing support for the ATP. It and the other NIST programs are working with industry to create key opportunities for our nation's future.

Sincerely,

Arati Prabhakar

Arati Prabhakar
Director

Enclosures

BioHybrid and Tissue Engineering

The new field of tissue engineering integrates engineering, biology, materials science, and medicine to create biomaterials or composites of cells and biomaterials that form functional substitutes for damaged tissues and organs. The health care cost for Americans who suffer tissue loss or end-stage organ failure exceeds $400 billion per year. Tissue-engineered skin replacements for burns and ulcers, functional substitutes for failed kidneys, pancreas, or livers, and effective substitutes for damaged bone, cartilage, tendons and ligaments are all potential new products that could become a reality during the next decade.

Fundamental work in this field at universities and medical schools is funded by the National Institutes of Health, but there is a long, expensive road from the fundamental understanding of the biology to the ability to manufacture tissue products for human patients that will be safe, effective, and inexpensive. NIH does NOT support work at companies taking the first steps to convert basic understanding to the point where commercial product development is possible. The ATP does.

Imagine microscopic plastic spheres (microreactors) that can be injected into the body with a hypodermic needle. Imagine that insulin-producing cells derived from animals can be put inside these spheres to produce insulin, that the insulin can seep out of the spheres into the body at the same rate as from a natural pancreas, and that nutrients can enter the spheres to keep the insulin-producing cells alive. Imagine that the body's immune system will not attack the microreactors. Were such a thing possible, diabetics could be freed from insulin injections and all of the debilitating side effects of diabetes.

The description above is not science fiction. It may be possible if success is achieved in an ATP-supported joint venture between BioHybrid Technologies Inc. of Massachusetts, a small company dedicated to development of artificial implantable organs, and Synergy Research Corporation of New Hampshire, a technology company with expertise in bioprocess engineering. Potentially, microreactors could be used to treat a variety of diseases, including Parkinson's disease and hemophilia.

Another ATP project in this same field was proposed by Tissue Engineering, a small startup company in Massachusetts founded by former MIT professor Eugene Bell, who some consider "the father of tissue engineering." Tissue Engineering's project is to find practical ways to manufacture exotic "tissue prosthesis" materials derived from animal byproducts — biodegradable materials that can serve as matrices upon which the body's cells can grow and eventually replace the damaged tissue. This project involves the integration of cellular biology with advanced textile manufacturing. Applications could include repairs for damaged periodontal, connective, and vascular tissue.

The high-risk, cost-shared R&D in the two projects described above represents first steps towards artificial tissue commercial products, but it will be many years before patients can benefit. First, many difficult technical problems must be solved associated with fabricating the materials and ensuring that they are safe and effective and can be made at an affordable price. Assuming that technical feasibility can be demonstrated during the ATP project (which is by NO means assured), BioHybrid and Tissue Engineering will still have a long, expensive road ahead after their ATP projects end, perfecting the manufacturing techniques, and embarking on FDA clinical trials required for product approval. That very expensive phase will, of course, be supported entirely on private funds.

The ATP Component-Based Software Program

One of the many paradoxes of the Information Age is that software — the very essence of the automated systems that move and process information, manage factories, maintain complex accounting and record-keeping systems — is produced much as 19th-century handcrafted products were. Shrink-wrapped commodity software for personal computers accounts for about 15 percent of the market; the balance is made up of large, custom systems for such things as financial services, manufacturing, or chemical processing. These systems are custom-built monoliths, produced one at a time at costs of up to tens of millions of dollars. The failure rate for developing these systems — projects that are started but never become fully operational — is reported to be about 70 percent. And because each software application is crafted from scratch, software productivity has not improved in decades.

The ATP Component-Based Software Program is five-year cooperative effort with U.S. software companies to establish the technology foundation for a fundamental change in software production. The key idea is to create techniques for automated software development that are sophisticated enough to compose software based on the intent of the developer, rather than following a huge number of error-prone instructions. Making this concept of semantically based software automation into a practical reality is an extremely risky undertaking. But if it can be done, the implications for the information revolution are enormous. As the concept of interchangeable parts fueled the industrial revolution a century ago, creating economies of scale and dramatic growth in productivity, this new capability could put software production on track to achieve comparable gains in productivity and reliability.

The ATP focused program in this area is the result of significant input from the information technology industry. There is no shortage of innovative ideas to make software generation dramatically simpler, more automated, more reliable. But the realities of the marketplace are such that the typical software company is struggling to finish its next job on time and on budget and cannot afford to engage in expensive, long-term, high-risk research to change the way software is developed. The widespread frustration within the industry was reflected in the dozens of software-related white papers the ATP received.

The ATP sponsored a series of workshops to explore the ideas in these white papers. The typical small software firm would find it difficult to justify the time and cost of sending a company representative to Washington, DC, to attend an ATP planning workshop, so the ATP went on the road, scheduling a workshop wherever there was a cluster of interested software firms. It became apparent that the industry was largely in agreement on the kind of work that is needed and the fact that the ATP could really make a difference by cost sharing this kind of pathbreaking R&D. The Component-Based Software program was launched in April 1994.

In the long term, this program envisions that vendors would be able to develop and market small, broadly useful software components. Buyers then would be able to characterize desired applications, and automated systems would match components with applications, reconfiguring the components as necessary to mesh with the final system. Conceptually, this is like marketing a light bulb that is automatically configured at the point of use to fit in whatever socket is there, at whatever voltage is present.

Software producers would be able to shift their emphasis from the mechanics of the software-development process to the more important task of meeting application needs by using automated tools to assemble and integrate independently produced components bought from specialized software component vendors.

The first competition for this program was held in 1994, and a variety of companies are now enthusiastically tackling various aspects of the vision outlined above. Many are small, innovative start-up companies. Examples include Aesthetic Solutions, Applied Parallel Technologies, Continuum Systems, Cubicon, SciComp, and Reasoning Systems. These are not household words today, but if the ATP program is successful, one or more of them may well be, five to ten years from now. Several larger computer companies have already come forward with matching funds for smaller companies who will be teaming with them. These firms will become partners in commercialization if the R&D cost shared by the companies and ATP is successful. These strategic alliances would not have occurred without the ATP.

THE ADVANCED TECHNOLOGY PROGRAM: QUESTIONS & ANSWERS

What is the Advanced Technology Program?

The Advanced Technology Program (ATP) is a research and development program which invests in cost-shared research by individual companies or joint ventures on high-risk, relatively long-term, technology R&D with the potential for a high pay-off for the U.S. economy. The ATP does not fund product development, but rather supports preproduct, *enabling* technologies that could underlie important new products, services or industrial processes for the world's markets — enabling technologies that industry would otherwise not pursue aggressively because of the risk of technical failure or because other obstacles discourage private investment. By reducing the early-stage R&D risks for individual companies, the ATP enables industry to pursue promising technologies which otherwise would be ignored or developed too slowly to compete in rapidly changing world markets.

How does a company receive funding from the ATP?

By submitting a detailed research proposal to an ATP competition. The ATP only accepts proposals in response to specific, widely publicized competition announcements published in *Commerce Business Daily*. ATP competitions are quite rigorous. Proposals are evaluated for both technical *and* business merit against five criteria:

- the scientific and technical merit of the proposal,
- the potential for broad-based economic benefits to the United States,
- the quality of the proposer's plans for eventual commercialization of the technology — the ATP does not fund product development, but the proposer should have plans for capitalizing on a successful project,
- the level of commitment of the proposer and the adequacy of their organizational structure, and
- the experience and qualifications of the proposer.

Who does the evaluations?

Proposals are reviewed for *technical* merit and feasibility primarily by federal and academic experts to avoid conflict-of-interest problems and protect proprietary information.

Potential economic impact, evidence of significant commitment to the project on the part of the proposer, and other business- and economic-related factors affecting the likelihood that successful results will be commercialized are evaluated primarily by business experts from the private sector who agree to avoid conflicts of interest and abide by non-disclosure requirements. Economic and business-related factors receive significant weight in ATP competitions.

Semifinalists receive in-depth oral reviews. Proposals are ranked according to published selection criteria, and funding is awarded on the basis of the ranking. This merit-based selection process has been fully tested and refined and is essential to the effectiveness of the ATP.

What technologies does the ATP support?

The ATP holds an annual *general* competition that is open to any and all technologies, provided the research meets the basic criteria: high-risk, pre-product development, enabling broad economic benefits.

In addition, the ATP has established several industry-driven *focussed program areas* to support the parallel development of a suite of projects aimed at specific, well-defined technical and business goals. By managing *groups* of projects which complement and reinforce each other, the ATP can have the greatest possible impact on technology and the economy.

How are these focussed program areas chosen?

On the basis of suggestions from private industry. ATP program areas originate in "white papers," largely from industry sources although submissions from government labs, universities and other organizations and private individuals are welcome. Each idea for a focussed program is evaluated against four key criteria:

- the potential for a significant impact on the U.S. economy, including the credibility of the program's proposed pathways to economic growth; the importance of the existing or potential sector(s) affected; and the probability of subsequent commercialization;

- good technical ideas that are "cutting edge," high-risk, strategically important, and based on sound scientific and technical concepts;

- a strong industry commitment to participate, including breadth and depth of interest and willingness to share costs and to work with the ATP and other partners; and

- an opportunity for the ATP to make a major difference by supporting work that is unique or complementary to other industrial and government efforts, that offers timely and significant acceleration of research progress, and that requires a critical mass of funding that the ATP can provide.

Through public meetings, workshops, and other consensus-building fora, like-minded white papers are forged into specific program goals. ATP programs have a fixed lifespan, generally about five years.

Does the ATP award research grants or contracts?

Technically, neither. The ATP transfers funds to selected projects through *cooperative R&D agreements* negotiated with NIST. These agreements involve considerably more oversight and interaction between NIST and the industrial sponsors than would be the case with a grant; they do not imply that NIST expects to receive a delivered product at the end of the project, as would be the case with a contract. Project sponsors are reimbursed for the ATP portion of the project on a quarterly basis.

Who may receive funding from the ATP?

By law, only for-profit companies and industry-led joint ventures are allowed to receive ATP funds. Universities, federal labs, and non-profit independent research organizations may not apply *directly* for ATP support, but they *can* receive funding through cooperative R&D relationships with companies. They also may participate in a joint venture that includes at least two for-profit companies, both of which are substantially involved in the R&D and both contributing towards the matching-fund requirement.

Any one of these three types of organizations can serve as the catalyst to organize a joint venture; however, of these three organizations, **only a non-profit independent research organization** may submit the proposal and administer the project provided that the following conditions are met: 1) The joint venture must include at least two for-profit companies, both of which are substantially involved in the R&D and both contributing towards the matching-fund requirement, and 2) The joint venture must be industry-led, i.e., the industrial members of the joint venture must define the research agenda and the commercialization plans based on their needs and must have the leadership role in programmatically controlling the project.

Does the ATP fund product development?

No. The ATP supports *pre-product* research, not the development of actual products. Typical ATP projects are expected to develop technologies that would enable a range of future products, processes or services within a given industry or group of industries. The broader the potential commercial benefits of the technology, the better the project proposal scores in ATP competitions.

Why do you say the ATP is "industry-led" or "market-oriented" when the funding decisions are made by government employees?

Because the ATP research agenda is set by U.S. industry. Industry conceives, proposes, manages and executes all ATP projects. The broad spectrum of projects selected in ATP general competitions reflects the diversity of industrial interests. ATP focussed programs derive from proposals made by industry, and reflect the consensus of broad segments of U.S. industry.

Wouldn't it be better to encourage this sort of commercial R&D through tax credits than through the ATP?

No, not if the goal is to achieve the same results as the ATP. R&D tax credit is a *complementary* policy approach to supporting commercial technology, but it should not be consider a *substitute* for the ATP. While both provide funding associated with R&D, they are implemented differently, address different problems, and entail very different amounts of money.

An R&D tax credit enables a company to reduce taxes owed, dollar for dollar, up to some percentage (e.g., 20%) by increasing spending on research and development. This *does* increase business expenditure in R&D, *but*:

- Only companies that owe taxes receive benefit from the credit (apart from working deals with other companies that do). This means that small start-up companies are less likely to be able to take advantage of the tax credit.
- A tax credit reduces the cost of R&D to companies able to take it; but it doesn't change the type of R&D performed. There is no evidence that R&D tax credits cause companies, particularly small companies, to undertake high-risk research over a sustained period to develop enabling

technologies with widespread benefits for industry and the economy, which is the point of the ATP. Companies eligible for the tax credit could be expected to undertake more R&D of the low-risk variety which benefits the company alone.

- The R&D tax credit would not provide special incentive for companies to come together in collaborative research to address the large, complex problems that are high in systems risk and high in industry-wide benefits, as the ATP provides. The ATP has demonstrated that it encourages just such cooperative R&D ventures.

In brief, the ATP is targeted specifically at increasing high-risk, early-stage R&D with large potential benefits to industry and the economy beyond those capturable directly by the investing company. R&D tax credits serve a completely different function.

NIST
UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-0001

March 20, 1995

Ms. Laurie C. Conner
Vice President
Marketing and Sales
Crystallume, Inc.
3506 Bassett Street
Santa Clara, CA 95054

Dear Ms. Conner:

In your letter dated February 9 to Subhash Kuvelker, you expressed concern over a joint-venture award to Norton Diamond Film and Kennametal, Inc., from the 1994 General Competition of the Advanced Technology Program (ATP). Your letter cites three areas of concern, including appropriateness of funding a foreign-owned entity, duplication of effort within the ATP, and possible release of proprietary information by the Technical Program Manager. The purpose of this letter is to address each of your points.

As you may know, Congress wrote the ATP legislation so as to permit U.S. subsidiaries of foreign-owned parent companies to receive awards provided that the proposed research projects meet specified eligibility conditions. If we were to refuse to fund foreign-owned companies carrying out research and manufacturing activities in the United States that met all the provisions of our law and had submitted highly ranked proposals, we would not only be failing to carry out the terms of our legislation, we probably would be in violation of the GATT agreements to which the United States is a party.

However, I can assure you that decisions to fund such firms are not made in a cavalier fashion. The ATP will fund a U.S. subsidiary of a foreign-owned parent company ONLY after verifying that all the eligibility provisions of the law were met and after completing a formal "finding" process described below. The ATP followed the procedure specified by Congress in funding a joint venture that included Norton, the U.S. subsidiary of a French-owned parent company, as a member.

The first eligibility condition is uniformly applicable to all proposals to ATP--whether the proposing companies are U.S. owned or foreign owned--participation of all companies in the program must be in the economic interest of the United States. Evidence of this includes investments in the United States in research, development, and manufacturing; significant contributions to employment in the United States; agreement with respect to any technology arising from assistance provided by the program to promote the manufacture within the United States of products resulting from that technology; and procurement of parts and materials from competitive suppliers. In addition, there are three country-specific eligibility conditions: the country of origin of the ultimate parent company must be found to afford to U.S.-owned companies participation in any joint venture similar to those authorized under the program; to afford to U.S.-owned companies local investment opportunities comparable to those afforded to any other company; and to afford adequate and effective protection for the intellectual property rights of U.S.-owned companies.

The first eligibility criterion--i.e., whether the project is in the economic interest of the United States--is determined for all proposals through ATP's thorough, fair, and rigorous review process. All proposals, regardless of the place of origin of the ultimate parent company are evaluated by teams of reviewers for both their technical and business merit and potential economic benefit for the United States. Multiple independent evaluations are performed for every proposal.

The award to Norton Diamond Film, like the award to Crystallume, Inc., was found by ATP Selection Boards and Selecting Officials to satisfy the first eligibility criterion, U.S. economic interest. Norton is a participant in a joint venture with a U.S.-owned company. Five additional U.S.-owned companies are involved in the joint venture, primarily in the commercialization aspects of the project, to take the technology into multiple commercial applications within the United States. These other U.S. companies clearly believe that the participation of Norton in the joint venture is in their best interests. First- and second-tier suppliers in the U.S. automotive and aerospace industries are also expected to benefit from the new technology in terms of international competitiveness. Norton employs thousands of U.S. workers.

As concerns the first country-specific eligibility condition, it is difficult to find precise ATP clones in the rest of the world, but it is possible to find programs somewhat analogous to the ATP in nearly every industrially advanced country in the world. In France, the R&D funding is administered mostly by the Ministry for Higher Education and Research (MHER) and to a lesser extent by the Ministry of Industry, Posts, and Telecommunications (MIPT). Two major R&D funding programs administered by MHER are the "Sauts Technologiques" ("Jump Technology") Program and the "Accion Concertee" ("Joint Action") Program. Applicants for both of these programs can be either a private enterprise or a public laboratory, including a university, either as a single-applicant or a joint-venture participant. According to the officials of the MHER and MIPT, the selection criteria are the same for all applicants, including foreign-owned companies. A list was provided to the ATP of U.S.-owned companies that have been funded under these programs (sources included Ms. Martine Beurton, Chief, Department of International and European Affairs, MHER; G. Postel-Vinay, Chief, Industrial Strategies Department, MIPT; and Mr. Jean-Luc Bourgeois, Chief of Grand Programmes, MHER.) Others familiar with the programs confirmed that U.S-owned companies are eligible and have received funding under these programs. Based on the evidence, the ATP determined that this national-treatment eligibility requirement was met.

With respect to the second country-specific eligibility requirement, the ATP relies heavily on the U.S. Trade Representative (USTR) to determine if the country of origin is imposing direct investment barriers on U.S.-owned companies. Often there are some items of issue between countries at any given time, with wide variations in the degree of severity and the progress that is being made. While there are currently some restrictions on acquisitions of existing French businesses, there are, according to the USTR, no restrictions on non-French companies seeking to establish subsidiaries in France; in fact, foreign-owned companies are welcomed as indicated by incentives from provincial governments, including R&D subsidies. Examples of U.S. companies which have established subsidiaries in France abound. This is reflected in international investment data--U.S. direct investment in France comprises a larger share of France's GDP than the reverse. Based on the evidence, the ATP determined that this national treatment eligibility requirement also was met.

The ATP also relies heavily on the USTR, together with the U.S. Patent and Trademark Office (PTO) in its determination regarding the adequacy and effectiveness of intellectual property protection. The USTR brings out problems of this nature in its "301 Fact Sheet." There were no problems of this kind identified by the USTR or the PTO. Hence, the ATP determined that this eligibility requirement was met.

Regarding duplication of effort, the three polycrystalline diamond programs funded by the ATP share only the same commercial application areas. Each proposal was considered independently, and in fact, submitted to different competitions. Careful evaluation showed that each proposal presented unique, high-risk approaches to the coating of rotating tools with polycrystalline diamond, and as such, each was appropriate for selection. The similarity of market sectors reinforces the possibility that this research, if successful, will have broad economic impact. The ATP may often fund more than one competing approach to overcoming a particular technical barrier. The marketplace will ultimately decide which solution is best.

Regarding treatment of proprietary information, all of our Technical and Business Program Managers are required to protect information in proposals and reports of ongoing projects. We take great care in handling information, and do not disseminate it beyond those at NIST formally charged with technical and financial management responsibility. Our Program Managers are well aware of these requirements and carefully avoid any contact or action which would compromise the information we hold.

We trust this information will help to allay your concerns. Please feel free to contact me directly if you have any questions. I can be reached at (301) 975-3778.

Sincerely,

Brian C. Belanger
Acting Director
Advanced Technology Program

cc: The Honorable Barbara Boxer
United States Senate

The Honorable Diane Feinstein
United States Senate

The Honorable Anna Eschoo
House of Representatives

The Honorable Norman Mineta
House of Representatives

bc: Esther Cassidy
John Gudas
Mat Heyman
Rosalie Ruegg
Marc Stanley

9 February 95

Via FAX: (301) 921-6319

Mr. Subhash Kuvelker
National Institute of Standards & Technology
Advanced Technology Program
Gaithersburg, MD 20899

Dear Mr. Kuvelker:

Mr. Robert Bloksberg-Fireovid suggested I contact you by FAX regarding the issue of NIST ATP awards to foreign owned corporations. We have a number of concerns regarding NIST's decision to fund a foreign-owned organization, Norton/Saint-Gobain, in the most recent ATP awards (94-01 General Competition). I have summarized them below.

Misdirected Investment of Government Funding to Foreign-Owned Concerns: First is the basic issue of funding a foreign owned entity from U.S. government (i.e. taxpayer's) funding. I have read your stipulations per Section 295.3 of the ATP rule and do not understand how this joint venture headed by French-owned Norton/Saint-Gobain could satisfy the constraints outlined therein? Where are the comparable government programs in France that "afford to United States-owned companies opportunities....similar to those authorized under this program;"?

Duplication of Effort: Second, NIST has already awarded two competitive programs addressing the diamond-coated tooling area, both to U.S.-owned joint ventures or consortia. Certainly one cannot argue that the technology was unavailable from U.S.-owned companies. Why did NIST ATP feel the necessity for a third program, when the funding will largely be going to a French-owned company?

Proprietary Technology: All of the three diamond-coated tooling programs are managed by the same Technical Program Manager. While I am certain that he would not wittingly share confidential or proprietary information of a technical or business nature with the French-owned joint venture, how can we be assured that information disclosed in a technical meeting is not shared with our foreign competitors?

It is difficult to see how your funding of a French-owned corporation addresses the stated goal of the ATP Program, which is " to stimulate economic growth in the United States through technology development." This issue is not about procuring a particular device from France which is unavailable in the United States. Your program is directly funding a research and development operation within a French company which will largely benefit a non-US owned organization and under-cut the U.S. technology base in this vital industry.

I would appreciate a response to my concerns at your earliest convenience.

Very truly yours,

Laurie C. Conner
Vice President
Marketing and Sales

cc The Honorable Congressman Norman Minetta
1245 South Winchester Blvd.
Suite 310
San Jose, CA 95128

The Honorable Congresswoman Anna Eschoo
698 Emerson Street
Palo Alto, CA 94301

The Honorable Senator Diane Feinstein
United States Senate
Washington, D.C. 20510

The Honorable Senator Barbara Boxer
United States Senate
Washington, D.C. 20510

ADVANCED TECHNOLOGY PROGRAM

National Institute of Standards and Technology

Diamond Tool Consortium

CVD Diamond-Coated Rotating Tools for Machining Advanced Composite Materials

Technologies:	Machining, tooling		
Project length:	3 years	**First year request:**	$621K
Total request:	$1,801K	**Private sector funds (est.):**	$1,830K

Diamonds have been used in industry for more than fifty years for certain limited, very difficult, cutting tasks. Those tasks are becoming more commonplace, as American industry increasingly turns to more competitive advanced materials such as fiber-reinforced plastics and advanced aluminum alloys — light and strong, but difficult to machine. The hardest, most abrasion-resistant material known, diamonds have other qualities ideal for tooling — high thermal conductivity, high temperature stability, and low chemical reactivity. But these same qualities make it very difficult and expensive to fashion diamond-tipped rotating tools. At present, the principal technique is to fuse small diamond particles together under high heat and pressure into a solid mass (a "PCD compact") which is brazed onto a tool surface and cut and polished to final shape. This method is only good for simple shapes, such as cutting inserts. Fashioning round, complex tools would be impractically expensive, or impossible. Recently, however, the National Center for Manufacturing Sciences sponsored an advanced research project at Crystallume to develop the technology for using chemical vapor deposition to coat diamond films on tungsten carbide inserts — tungsten carbide because its toughness and ease of machining make it the material of choice for high-performance tooling. Crystallume solved the single most critical problem which had stymied other attempts: getting the diamond to adhere tightly to the tungsten carbide surface. CVD diamond coatings on simple cutting inserts perform even better than PCD-tipped tools. In principle, it should be possible to extend the Crystallume technology to put CVD coatings on more complex tools such as drills, end mills, routers or taps, but this involves overcoming several challenging technical barriers to bond the diamond film to complex shapes tightly, evenly, and while maintaining the critical dimensions of the tool. Crystallume has joined with Rogers Tool Works, General Motors, Ford Motor Company, Hughes Aircraft Company, Boeing Commercial Aircraft Company, and BDM International in a joint venture to solve these problems and develop a CVD diamond technology for rotating tools suitable for large-scale production.

Contact: Robert Corwin, (415) 324-9681

93-01 (November, 1993)

AwD. # 2

AWD #1

ADVANCED TECHNOLOGY PROGRAM

National Institute of Standards and Technology

Westinghouse Electric Corp. — SGS Tool Company

Plasma Technology for Low-Cost Diamond Production

Technologies:	Materials/diamond films		
Project length:	3 years	**First year request:**	$1,079K
Total request:	$2,473K	**Private Sector Funds (est.):**	$2,741K

The technology of making and using diamond films has advanced to the point where the utility of this advanced material is no longer questioned. Widely recognized as one of the hardest known substances, diamond also has the highest thermal conductivity of any known material, is extremely transparent from infrared wavelengths into the far ultraviolet, has high electrical resistivity, is an excellent electrical barrier, is corrosion resistant, has a low coefficient of friction, and even has some useful properties as a semiconductor. From mechanics to optoelectronics, forecasts estimate the annual diamond film market at $4 billion within a decade. The current technology race is to develop efficient, high-volume commercial production technology for diamond films. Japanese industry developed the first practical production methods in the '80s. There are several competing technologies for laying down high-quality diamond coatings on surfaces, but one of the most promising is arc plasma chemical vapor deposition. Westinghouse and SGS, working with the University of Minnesota, plan to scale up the arc plasma process from the current 15 kilowatt power level to 1 megawatt, the maximum area per unit from roughly 80 to about 6,500 square centimeters, and the production rate from less than 1 unit per hour to more than 100. This technology should drive the cost of diamond coatings from today's level of about $30 to less than $5 per carat, giving U.S. industry an important lead in capturing a significant share of the emerging diamond film market. The project also includes plans to develop technologies for incorporating diamond films into products such as tooling, heat sinks and infrared optics; and to create an industrial users group to speed technology transfer.

Sponsor's Contact: Robert Benke, (412) 642-3321

91-01 (April, 1992)

AwD. #3

Advanced Technology Program

U.S. Department of Commerce

Technology Administration

National Institute of Standards and Technology

Norton Diamond Film & Kennametal, Inc.

Accelerated Commercialization of Diamond-Coated Round Tools and Wear Parts

Technologies:	Materials science
Project length:	2 years
ATP funds:	$2,005 K
Cost-shared funds (est.):	$2,163 K
Total project funds (est.):	$4,168 K

Norton Diamond Film and Kennametal, Inc., propose to combine their technical strengths in synthetic diamond-film technology and ceramic and carbide metal (such as tungsten carbide) materials to develop diamond-coated tools and wear parts such as seals that last 10 to 100 times longer than conventional counterparts. Subcontractors on the projects include General Motors, Ford, Boeing, and Cummins, all of which will serve as testbeds for development in automotive and aerospace manufacturing settings. Three main challenges of the project are to improve the adhesion of the diamond film onto the metals that comprise the bulk of the tools and components; to be able to reliably coat complicated three-dimensional round shapes; and to coat areas large enough to make the process economically sound. Kennametal's main task is to prepare special tungsten carbide alloys tailored for coatability by diamond films and that also are suited for the shaping and forming procedures of factory scale manufacturing. Norton's challenge is to develop its CVD (chemical vapor deposition) coating technology, in which high-quality diamond films are made from hydrogen methane, into a routine means of producing adherent, uniform diamond coatings on three-dimensional surfaces on a scale that makes commercial sense.

Contact: Rob Hay, (508) 351-7864

94-01 General Competition (November 1994)

AWD # 1

ADVANCED TECHNOLOGY PROGRAM
National Institute of Standards and Technology

Westinghouse Electric Corp. — SGS Tool Company

Plasma Technology for Low-Cost Diamond Production

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Project length:	3 years	**First year request:**	$1,079K
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Sponsor's Contact: Robert Benke, (412) 642-3321

91-01 (April, 1992)

AWD. #2

ADVANCED TECHNOLOGY PROGRAM

National Institute of Standards and Technology

Diamond Tool Consortium

CVD Diamond-Coated Rotating Tools for Machining Advanced Composite Materials

Technologies:	Machining, tooling		
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Contact: Robert Corwin, (415) 324-9681

93-01 (November, 1993)

AWD. #3

ATP

Advanced Technology Program

U.S. Department of Commerce

Technology Administration

National Institute of Standards and Technology

Norton Diamond Film & Kennametal, Inc.

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Cost-shared funds (est.):	$2,163 K
Total project funds (est.):	$4,168 K

Norton Diamond Film and Kennametal, Inc., propose to combine their technical strengths in synthetic diamond-film technology and ceramic and carbide metal (such as tungsten carbide) materials to develop diamond-coated tools and wear parts such as seals that last 10 to 100 times longer than conventional counterparts. Subcontractors on the projects include General Motors, Ford, Boeing, and Cummins, all of which will serve as testbeds for development in automotive and aerospace manufacturing settings. Three main challenges of the project are to improve the adhesion of the diamond film onto the metals that comprise the bulk of the tools and components; to be able to reliably coat complicated three-dimensional round shapes; and to coat areas large enough to make the process economically sound. Kennametal's main task is to prepare special tungsten carbide alloys tailored for coatability by diamond films and that also are suited for the shaping and forming procedures of factory scale manufacturing. Norton's challenge is to develop its CVD (chemical vapor deposition) coating technology, in which high-quality diamond films are made from hydrogen methane, into a routine means of producing adherent, uniform diamond coatings on three-dimensional surfaces on a scale that makes commercial sense.

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